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# LITERATURE SURVEY OF SOLID WASTE/DISEASE RELATIONSHIPS. VOLUME II. ANNOTATED BIBLIOGRAPHY. PART 1

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# LITERATURE SURVEY OF SOLID WASTE/DISEASE RELATIONSHIPS

## VOL. II - ANNOTATED BIBLIOGRAPHY, PART 1

By T. G. HANKS, M. D.

Final Report To

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
BUREAU OF STATE SERVICES
UNITED STATES PUBLIC HEALTH SERVICE
OFFICE OF SOLID WASTES

Contract PH 86-66-151

Report No. 3337 January 1967

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## FOREWORD TO ERRATA

Following a time-trial covering 40 documents, proof-reading of the annotated bibliography prior to its reproduction was eliminated as too costly in time and money. The decision has resulted in much meatier, if less error-free, abstracts.

Substantive errors were left to be picked up in the study and collation period following printing, and are noted (insofar as they were identified) in the tables of errata. Typographical errors and minor misspellings of technical terms are not included in the tables.

## ERRATA (Vol. II - Annotated Bibliography, Part 1)

DSW NO.

7 Add (Descriptors): recreation areas, roadside parks, food, hosts, mammals, birds, reptiles, amphibians

8 Add (Descriptors): Diptera, flies, mosquitoes, vectors, muscoids, pathogenic organisms, filth, food, larvae

20 Third line from bottom should read: ... that the coliforms form only a small...

22 Issue date: November 1962

31 Page 2, sixth line should read: ...ingested pathogens, 6-15 per cent....

32 Fifth line should read: ... expense of tackling them....

33 Add (Descriptors): sewage treatment, microorganisms, disease, bacteria, media, culture, viruses, fungi, filter (trickling), sludge (activated), stabilization ponds, anaerobic digestion, chlorination

34 Add (Descriptors): cancer, environment, carcinogenesis, smoking, exposure, atmospheric pollution, air pollution, fuel, viruses

36 Add (Descriptors): viruses, water, transmission, sewage, water treatment, chlorination

37 Title should read: The Effect of Animal Disease on Human Food Supplies: A Review of the World Position

44 Add (Descriptors): carcinogens, soil, asphalt, tar, soot, solvents, benzopyrene.

45 Add (Descriptors): detergents, carcinogens

46 Add (Descriptors): river, water supply, non-cancerogenic hydrocarbons, fluorescing substances, dosage, cancerogenic substances, carbon filtration, exposure, cancerogenic hazards

47 Add (Descriptors): domestic sewage, chemical groups, composition of sewage, sewage purification, phenols, uric acid, vitamins, skatol, fats, proteins

## Vol. II ERRATA (continued)

DSW NO.

51 Add (Descriptors): trout, liver cancer, feed, nutritive factor, chemical additive, medicinal agent, cancer, human population, contamination

52 Add (Descriptors): trachoma, family, contacts, unsanitary conditions, temperature, irritants, infection, diet, disease

53 Add (Descriptors): poultry meats, eggs, ham, beef, pastry, pork, salads, fish, diarrhea of newborn, *Salmonella*, *S. paratyphi*, *B. Shigella*

58 Page 3: The titled "Research" is duplicated

59 Add (Descriptors): barnacle, fluorescence, polycyclic aromatic hydrocarbons, 3, 4-benzpyrene, metabolic products, ships, intertidal sedentary animals, source

69 Add (Descriptors): flocculation, sand filtration, pH levels, chlorine, treatment methods, disinfection

75 Add (Descriptors): *Shigella* infections, diarrheal diseases, sanitation, spread of disease, disaster, warfare, passage of organisms, taxonomy, bacteriological techniques, mechanical vectors, fly control, poliomyelitis, *Shigella* infections, deaths, shigellosis, gnats, yaws, DDT

77 Add (Descriptors): Musca, refuse, dung, houseflies, organic residues, poliomyelitis, carriers, bacteria, tuberculosis, leprosy, yaws, worms

78 Add (Descriptors): *Salmonellae*, health hazards

79 Add (Descriptors): eluates, industrial chemical pollutants, sarcomas, leukemic reactions, bladder, papilloma, contamination, drinking water, cancer hazards, fruits, soil

82 Add (Descriptors): trace quantities

83 Add (Descriptors): infectious hepatitis, season variation, contact. spread, clinical features, disease, virus, transmission, fecal suspension, incubation period, excretion

## Vol. II ERRATA (continued)

| DSW NO. | |
|---|---|
| 84 | Issue Date: December 1965; Add (Descriptors): flies, domestic flies, public health, waste preference, dispersion, backyard sources, compost piles, dog and cat droppings |
| 86 | Add (Descriptors): enormous economic loss, waste, "wet straw piles or strawy manure, sewage disposal plants, house flies, garbage, excrement. Also, page 3, first line should read: America" (p. 942-3). .... |
| 90 | Correct descriptors to read: ... Paratyphoid ...Infantile diarrhea ... Anthrax.... |
| 96 | Add (Descriptors): soil, soil sickness, ciliates, cultivation, peas, yield |
| 98 | Author: G. A. Lamb |
| 100 | Author: M. L. Furcolow |
| 102 | Page 2, line 16 should read: ...intoxication in a small boy who.... |
| 113 | Abstract should read: Entamoeba histolytica found in 13 of 202 cases. Other parasitic infections were found. Forty-two cases were positive for one or more parasites. |
| 114 | Title should read: ...Strains of E. Histolytica.... |
| 147 | Add (Descriptors): fertilizer, poultry feed, animal disease |
| 157 | Author: C. M. Eklund, G. M. Kohls, and W. L. Jellison |
| 160 | Ninth line should read: ...against either the Western equine....<br>Add (Descriptors): domestic fowl, reservoirs, mosquitoes, horses |
| 162 | Second paragraph, first line should read ...true epizootic among....<br>Second paragraph, fourth line should read ...wild rodent epizootic in....<br>Page 2, seventh paragraph should read: As a whole, the....<br>Add (Descriptors): epizootic, infested nests, ecological, host preference, bionomics, ectoparasites, squirrel fleas |
| 165 | Add (Descriptors): Joint tenancy |

## Vol. II ERRATA (continued)

| DSW NO. | |
|---|---|
| 179 | Paragraph 4 should read: Attention is drawn.... |
| 194 | Add (Descriptors): excrement, human food |
| 195 | Add (Descriptors): entomophobia, sludge, gnats, trachoma, "pinkeye", poliomyelitis |
| 199 | Add (Descriptors): advent of the house-fly, horse dung, infantile diarrhoea, fly prevalence, outbreak of enteric |

**Disease/Solid Waste**
**Abstracts**

No. DSW-1

**Author**

Report of a WHO Expert Committee

**Title**

Enteric Infections

**Reference** World Health Organization Technical Report Series

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 288 pp. 15-22 | | 1964 |

**Abstract**

Infectious enteric diseases, including acute diarrhoeal disease, are public health problems of varying degrees of severity in all areas of the world where one or a combination of the following conditions occurs:

(1) Knowledge of personal hygiene is inadequate to prevent transmission of enteric organisms by personal contact.
(2) Sanitation facilities are inadequate to prevent contamination of the environment with human excrement.
(3) Economic resources are insufficient to provide adequate nutrition.
(4) Care of children is inadequate to protect them from infection.
(5) Medical resources are inadequate or are not properly utilized.

Because of the complex iterrelation of biological, social, and economic factors that enable diarrhoeal diseases to persist, it is as well to mention some of these factors with a view to developing bases for selecting or developing control techniques.

. . . the various etiological entities cannot be differentiated by clinical criteria and in a large proportion of cases no recognized etiological agent can be demonstrated in acute diarrhoeal disease. Thus, while the importance of microorganisms associated with diarrhoea cannot be minimized, it is apparent that synergistic or potentiating factors may profoundly affect the response to infection. The possibility of a non-infectious etiology of acute diarrhoeal disease should not be overlooked. . . .

Various studies have suggested that response to enteric infections is determined by host resistance and immunity. . . .

**Descriptors**

## Abstract (continued)

It has long been recognized that acute diarrhoeal disease occurs more frequently and with greater severity among malnourished children than among children who are well nourished. . . The work of the WHO Diarrhoeal Diseases Team in Mauritius indicated, however, that malnutrition and diarrhoea exist independently. The occurrence of malnutrition was uniform throughout the year but diarrhoea tended to follow a seasonal pattern, with most cases occurring during the warm months.. . .

The consistent decline in morbidity and mortality from diarrhoeal disease in some areas of the world during the past century has been attributed largely to improvements in environmental sanitation. While public health workers do not question the propriety or desirability of control through environmental sanitation, there is disagreement as to whether priority should be assigned to preventive or to curative programmes in areas with acute problems resulting from enteric infections.

. . . Properly used control measures that suppress or preclude direct or indirect anal-oral transmission of faecal material and contamination of food, water and soil include: (a) a safe, adequate water supply under pressure within each home; (b) sanitary methods for excreta disposal within each dwelling, and prevention of faecal pollution of ground-and surface-water supplies; (c) sanitary collection and disposal of human, animal and industrial wastes; (d) prevention of access of vectors - namely, insects and intermediate hosts of schistosomes - to human or animal faeces; (e) housing which is spacious enough to avoid excessive crowding and which is free from rodents, vermin and domestic animals; and (f) sanitary controls governing the production, processing, storage and consumption of milk and food.

Water supply - The evidence of the importance of safe municipal water supplies in controlling and preventing water-borne outbreaks of typhoid fever and cholera is highly persuasive. Similar evidence, however, of the effect of such developments on the reduction of morbidity and mortality due to diarrhoeal disease is largely presumptive. . . . . . . High rates of prevalence in Guatemala, as in the USA, were associated with the lack of sanitary facilities, poor housing, limited water supply, and poor personal hygiene. (1)

### Disposal of excreta

It is generally acknowledged that reductions in typhoid fever as well as in helminthic and protozoal infections follow the installation of facilities for sanitary disposal of excreta. Furthermore, a 50% reduction in the diarrhoea and enteritis death rate in Costa Rica over an eight-year period has been attributed to the installation of more than 10,000 privies.(1).

The associateion of severe problems of enteric infection with poor economic circumstances is axiomatic. . . .

Lack of knowledge or lack of initiative, or both, are probably the most significant factors in the persistence of enteric infections. The full benefit of sanitary improvements has often not been realized because the facilities thus provided are not properly used. . . . . . the persistence of acute diarrhoeal disease in areas with satisfactory sanitary facilities can be attributed to the poor hygienic practices of individuals. Appropriate instruction of the population is an essential accompaniment of environmental improvement. On the other hand, in the absence of satisfactory sanitary facilities instruction in hygienic practices is likely to be ineffective.

## Abstract (continued)

Understanding of the health and social significance of water supply and excreta disposal and of methods of food handling and of baby care is a foundation of health education in the prevention of enteric infections.. .

. . . Health education with emphasis on the importance of controlling the enteric infections should begin in primary school and continue in secondary school. . .

The Committee examined data that clearly show a correlation of lower rates ofdiarrhoea and certain enteric infections with higher levels of environmental sanitation. It was acknowledged that, despite the multiplicity of etiological agens and differences in mode of spread, prevention of enteric infections is dependent upon the availability and use of thos environmental sanitation facilities that reduce direct and indirect transmission of infectious agents and preclude faecal contamination of the environment. In order of priority, factors essential to the suppression of enteric infections seem to involve water supply, excreta disposal, municipal and industrial waste disposal, vector control, housing, and sanitation of food and milk products.

. . . no single factor approaches the significance of a safe, adequate water supply. . . . . . . . major emphasis should be placed on the provision to each dwelling of, first, a safe supply of water and, second, facilities for the sanitary disposal of excreta. Concentration of effort on other environmental controls should be deferred until these objectives are attained. . . .

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DESCRIPTORS

enteric infections
infectious enteric diseases
diarrhoeal disease
public health
personal hygiene
personal contact
sanitation
contamination
environment
human excrement
economic resources
nutrition
children

infection
medical resources
etiological
micro-organisms
host resistance
immunity
malnutrition
seasonal pattern
morbidity
mortality
control measures
excreta disposal
faecal pollution

wastes
vectors
faeces
housing
rodents
vermin
domestic animals
milk
food
water supply
helminthic
protozoal infections
death rate

privies
toilets
flies
socio-economic
educational factors
social gathering
communal feeding
social status
food handlers
infant-feeding
child care
education

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Reference

1. McCabe, L.J. & Haines, T.W. (1957) Diarrheal disease control by improved human excreta disposal. Publ. Hlth Rep (Wash.), 72, 921

**Disease/Solid Waste**
**Abstracts**

No. DSW-2

**Author**

J.P. Tassoney, R.L. Albright & E.B. Stuart

**Title**

Batch Process Removes Oil, Fat, Grease

**Reference**

Water Works & Waste Engineering, August 1964

| Doc. No. | Contract No. | Date issu |
|---|---|---|
| | p. 38 | |

**Abstract**

Successive chemical treatment and contaminant removal under continuous operator surveillance insures a high degree of treatment for a difficult-to-handle waste produced in the manufacture of lubricating greases and other petroleum lubes and specialty products.

Examination of data for the raw waste will show the complexity of the waste discharged from the plant. The primary contaminants from the standpoint of discharge to either the sewage treatment plant or to the Allegheny River are fats, grease, and oil.

Oil, fats, and greases seriously interfere with the sedimentation stage in the operation of a primary sewage treatment plant....These substances tend to form aggregates with particles of other settleable materials and hold them in suspension.

The process consists of springing the fats, greases and oils by reacting the sodium soaps with calcium chloride...the sludge is removed along with the separated calcium soaps.

The sludge is heated and then pumped from the bottom of tank T-300 by pump P-301 into a tank truck and hauled away.

The effects of alum, lime and acid addition are consistent with the basic theory of chemical treatment. An additional analysis for lead content was made on the last three samples. Using a chromate determination for lead, analysis gave negative results, confirming the original prediction that flocculation of the suspended solids would provide removal of metallic contaminants.

**Descriptors**

flocculation
sludge
metals
oil
chemical treatment
sedimentation
suspended solids
waste
disposal
fats
raw waste
metallic contaminants
constituents
removal
grease
contaminants

**Abstract (continued)**

### TABLE I

Grab Samples Taken at Various Collection Points Show Range of Waste Quality

| Sample | No. 1 | No. 2 | No. 3 | No. 4 |
|---|---|---|---|---|
| pH Value | 8.7 | 8.9 | | |
| Turbidity | 5,000 ppm | 5,000 ppm | | 150 ppm |
| Settleable solids 1 Hr. Imhoff Cone | | | 2 ppm | 0.5 ppm |
| Total Solids | 9,092 ppm | 122,280 ppm | 894 ppm | 683 ppm |
| Suspended Solids, total | 7,014 ppm | 70,020 ppm | 254 ppm | 105 ppm |
| Suspended Solids, volatile | 6,296 ppm | 78,210 ppm | 2 ppm | 102 ppm |
| Suspended Solids, fixed | 718 ppm | 1,810 ppm | 252 ppm | 3 ppm |
| Dissolved Solids, total | 2,078 ppm | 52,260 ppm | 640 ppm | 578 ppm |
| Dissolved Solids, volatile | 1,682 ppm | 45,520 ppm | 536 ppm | 65 ppm |
| Dissolved Solids, fixed | 395 ppm | 6,740 ppm | 104 ppm | 513 ppm |
| Oil & Fats, total | 43,821 ppm | 89,020 ppm | 56,370 ppm | 64 ppm |
| Chlorine Demand | 51.1 ppm | 61.3 ppm | 20.4 ppm | 10.2 ppm |
| Oxygen Demand by Chromate | 51.2 ppm | 2,146 ppm | 208.8 ppm | 11.2 ppm |
| Total Iron (as Fe) | 1 ppm | 1 ppm | 0.8 ppm | 1.5 ppm |
| Sulfates as $SO_4$ | 67 ppm | 165 ppm | 63 ppm | 279 ppm |
| Lead | 134 ppm | 2,392 ppm | 4 ppm | 2 ppm |
| Alkalinity as $CaCO_3$ | 232 ppm | 2,384 ppm | 40 ppm | 42 ppm |

### TABLE II

Treatment Record and Final Effluent Quality

| Batch | Tank | Lbs. $CaCl_2$ | Lbs. Alum | Lbs. Lime | Gals. Acid | Ppm Suspended Solids | pH | Oil |
|---|---|---|---|---|---|---|---|---|
| 33 | 201 | 100 | 15 | 8 | - | Nil | 9.0 | Nil |
| 34 | 200 | 100 | 15 | 22 | - | - | - | - |
| 35 | 201 | 100 | 13 | 8 | - | Nil | 6.7 | Nil |
| 36 | 200 | 100 | 12 | 7 | - | Nil | 7.0 | Nil |
| 37 | 201 | 100 | 13 | 12 | - | Nil | 7.8 | Nil |
| 38 | 200 | 100 | 13 | 7.5 | - | Nil | 8.1 | Nil |
| 39 | 201 | 100 | 13 | - | 1.5 | Nil | 7.4 | Nil |
| 40 | 200 | 100 | 25.5 | 1.5 | 2.5 | Nil | 8.2 | Nil |
| 43 | 201 | 100 | 15.5 | 10 | 2.5 | Nil | 8.4 | Nil |
| 44 | 200 | 100 | 25 | 7 | - | Nil | 6.2 | Nil |
| 45 | 201 | 100 | 15 | 7.5 | - | Nil | 6.4 | Nil |
| 47 | 201 | 100 | 15 | 5 | - | Nil | 8.0 | Nil |

Abstract (continued)

TABLE III

Operating Cost Data

| | | |
|---|---|---|
| Direct costs | | |
| Labor | $1,600 | |
| Chemicals | 684 | |
| Other | 564 | |
| Sub-total | $2,848 | |
| | | $2,848 |
| Indirect costs | | $1,225 |
| Depreciation at 5% per year based on a plant cost of $120,000 | | 2,500 |
| Total for five months | | $6,573 |
| 102 Batches processed through August, 1960 or 1,020,000 gallons | | |
| Operating cost | | |
| per gallon | $0.00645 | |

Disease/Solid Waste
Abstracts

No. DSW-3

Author

Donald M. McLean

Title

Contamination of Water by Viruses

Reference

Journal of American Water Works Association

| Doc. No. | Contract No. | Date issued |
|---|---|---|
|  | p. 585 | May 1964 |

Abstract

The presence of many bathers in a body of water may provide suitable conditions for the spread of viruses. Outbreaks of sore throats and "pink eye" accompanied by fever, caused by[2]adenovirus-3 in Washington, D.C., in 1954[1] by adenovirus-7 in Toronto, in 1955, were attributed to the use of swimming pools. The spread of vesicular exanthem, caused by Coxsackie A16 virus, in Toronto, in 1957[3] may have been aided by the use of backyard swimming pools. Swimmers at two fresh-water beaches along Lake Michigan showed approximately twice the incidence of gastrointestinal and ear and throat infections as did non-swimmers.

During the summers of 1960-62, two outdoor public swimming pools were investigated in Toronto. Free chlorine residuals in both pools were consistently maintained above 0.1 ppm and no virus was isolated from either pool.

Between October and December 1962, the disinfectant properties of bromine were examined in Pool 5. A bromine residual of 1.0-2.0 ppm was maintained.[12] Virtually no bacterial contamination was observed with bromine residuals 2.0 ppm or greater, and no virus was detected.

A study conducted in 1956 detected considerably higher concentrations of organisms on the surface of swimming pools than in water taken from 1 ft below the surface.[13] Staphylococci and Streptococcus viridans were found mainly on the surface, but few coliform organisms were detected there. Among organisms present in water obtained beneath the surface, however, coliform bacteria predominated.

Lakeshore Studies

Gross bacterial contamination, with coliform-organism indexes exceeding 1,000 per 100 ml, was observed frequently in Lake Ontario and the small lakes, but infrequently in Lake Erie and Lake Huron.[9] Viruses were not recovered from any site, despite fairly heavy contamination, on several occasions, of one Toronto beach with sewage.

Descriptors

Adenovirus-3
Adenovirus-7
Coxsackie A16 virus
Disease
Gastrointestinal and ear and throat infections
Infectious hepetitis
"Pink eye"
Sore throats
Vesicular exanthem
Virus
Water

Drinking Water Studies

Epidemiologic evidence gathered during several subsequent outbreaks in Pennsylvania, New York, Kentucky, Austria, India, and Australia has strongly suggested that they were caused by drinking water contaminated with infectious-hepatitis virus.[14]

River water. An enormous outbreak of hepatitis occurred in New Delhi, India, during 1955-56. City water was drawn from a river extensively polluted by raw sewage. Although additional chlorine was added to produce a bacteriologically acceptable water, the hepatitis virus remained active.

At Bathurst, Australia, clinically typical hepatitis occurred in 6 of 19 students who drank raw water from the Macquarie River. The river was polluted by effluent from the city sewage works located upstream.

Hepatitis virus in water retained its infectivity for human volunteers after 30 min contact with a chlorine residual of 1.08 ppm and after flocculation and filtration through activated carbon. The virus's infectivity was inactivated completely, however, by exposure of flocculated, charcoal-filtered water to a chlorine residual of 15.23 ppm for 30 min. Because chlorine residuals exceeding 1.0 ppm were unacceptable for drinking water, the excess chlorine was removed by treatment with sodium sulfite.

1. Bell, J. A., et al. Pharyngocojuncitval Fever. Epidemiological Studies of a Recently Recognized isease Entity. J. Am. Med. Assoc., 157:1083 (1955).

2. Ormsby, H. L. & Aitchison, W. S. Pharingeal-conjunctival Fever Due to Swimming Pool Contact. Can. Med. Assoc. J., 73:864 (1955(.

3. Robinson, C. R.; Doane, F. W.; & Rhodes, A. J. Report of an Outbreak of Febrile Illness with Pharyngeal Lesions and Exanthem: Toronto, Summer 1957 - Isolation of a Group A Coxsackie Virus. Can. Med. Assoc. J., 79:615 (1958).

9. Brown, J. R.; McLean, D. M.; & Nixon, M C. Swiming Pools and Bathing Places in Southern Ontario: Chemical and Microbiological Studies During 1962. Can. J. Public Health, 54:121 (1963).

12. Brown, J. R.; McLean, D. M.; & Nixon, M. C. Bromination of Swimming Pools. Can. J. Pub. Health (in press).

13. Amies, C. R. Surface Film on Swimming Pools. Canad. J. Pub. Health, 47:93 (1956).

14. Mosely, J. W. Water-Borne Infectious Hepatitis. New Eng. J. Med., 261:703, 748 (1959).

Disease/Solid Waste
Abstracts

No. DSW-4

Author
Robert Lewis, PH.D., Murray M. Gilkeson, Ph.D., and Roy O. McCaldin, Ph.D.

Title
Air Pollution and New Orleans Asthma

Reference
Public Health Report, Vol 77, No. 11, Nov 1962

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | p. 947 | |

Abstract

Findings indicated that some air contaminant was involved in the attacks and that the source of this contaminant was most probably located upwind and not far removed from the respondents.

A statistically significant relationship was found between the daily asthma admissions at Charity Hospital emergency clinic and the prevalence of one air pollutant, a poor combustion particle with associated silica.

If subterranean burning in the dumps could be stopped, and this is recognized to be a substantial undertaking, it would be possible to compare the current seasonal asthma rate with rates for previous years and to determine whether cessation of dump burning brings about a reduction in asthma in New Orleans.

Descriptors
Air Pollution
Asthma
Constituents
Disease
Silica
Waste

Disease/Solid Waste
Abstracts

No. DSW-5

Author
R. W. Hegner

Title
Transmission of Human Protozoa[1]

Reference
Science, Vol LXIV, No. 1645 1926

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | p. 28 | |

Abstract

Every class in the phylum Protozoa contains species that live in man, and some of these are of considerable importance in various parts of the world as disease-producing agents.

One of the most interesting phases in the life cycle of these parasitic Protozoa is that during which they are transmitted from one host to another, either directly or through an intermediate host. It is at this time that measures for prevention and control can most successfully be applied. Twenty-five species of human Protozoa are usually recognized by protozoologists at the present time.

The prevention of transmission of intestinal Protozoa is largely a sanitary problem. There is a tendency for these organisms to spread in families which is suggestive. Soiled hands, the common towel, food that is insufficiently cooked after becoming contaminated by food handlers in markets, restaurants and private homes all favor infection. Efforts to control should be directed toward the elimination of soil pollution, the better disposal of human excrement, the screening of latrines from flies and the destruction of these and other insects, such as ants and cockroaches, that may be responsible for the contamination of food by fecal material containing cysts.

So far as is known all the blood-inhabiting Protozoa of man are transmitted by insects and each species of protozoon is carried by one or a very few species of insects. This has an important influence on the geographical distribution of this type of protozoon. Intestinal species have been found wherever man exists, but blood-inhabiting species are restricted in their distribution to the habitats of their insect vectors.

Trypanosomes. Trypanosoma Gambiense and Trypanosoma rhodesiense, the organisms of African sleeping sickness, are usually transmitted by tsetse flies belonging to the species Glossina palpalis and Glossina morsitans, respectively. Many lower animals, as well as man, are susceptible to infection with these species of trypanosomes and

Descriptors
African sleeping sickness
Ants
Cockroaches
Disease
Fleas
Leishmanias
Protozoa
Trypanosomes
Trypanosoma gambiense
Trypanosoma rhodesiense
tsetse flies
sand flies

wild game, especially antelopes, are supposed to serve as reservoirs from which the tsetse flies may acquire their infection.

Leishmanias. The literature regarding the transmission of the *leishmania* Protozoa that cause kala-azar, oriental sore and espundia is very extensive, but most of it is inconclusive. Bedbugs, fleas and sandflies have been suspected, but at the present time it can only be stated that sandflies of the genus *Phlebotomus* are known to transmit *Leishmania tropica* of oriental sore and probably transmit those of the other two diseases as well.

1. From the Department of Medical Zoology, School of Hygiene and Public Health, the Johns Hopkins University and the London School of Hygiene and Tropical Medicine. This paper is an abstract of three lectures delivered at the London School of Hygiene and Tropical Medicine on April 18, 19 and 20, 1926.

Disease/Solid Waste
Abstracts

No. DSW-6

Author
Teofil Szulga, Zbigniew Wieczorek, Janina Madra and Haline Kowalczyk

Title
Classification of Acid-fast Bacilli Isolated from the Milk of Cows and from Sewage Used for Fertilizing Pastures

Reference
Archivum Immunologiae et Therapiae Experimen-

| Doc. No. | Contract No. | Date issued |
|---|---|---|

talis, 1965, 13, 336

Abstract

Conclusions

1. Of 110 strains isolated from the milk of cows or sewage, 9 proved to be human type tubercle bacilli, and 4 were bovine tubercle bacilli.

2. Of the remaining 97 strains, 2 were avian strains and 46 potentially virulent (of which 10 were orange and 38 apigmented), 41 exhibited characteristics resembling those of saprophytes (32 orange and 9 apigmented), and 8 were saprophytes.

3. Strains capable of surviving in the tissues of inoculated mice for 8 weeks were classified into the group of potentially virulent strains (group 11).

4. The classification of wild strains of acid-fast bacilli requires the use of a large number of differentiating tests (Table 5).

Descriptors

Acid-fast Bacilli
Fertilizing
Sewage
Tuberculosis

Disease/Solid Waste
Abstracts

No. DSW-7

Author

Dale W. Jenkins

Title

Trombiculid Mites Affecting Man

I. Bionomics with ref to Epidemiology in the U.

Reference

Am. J. Hyg. 1948, Vol. 48:pp. 22-35

| Doc. No. | Contract No. | Date issue |
|---|---|---|

Abstract

In the U.S. the species of trombiculid mites known to attack human beings are Eutrombicula alfreddugesi (Oudemans), E. masoni (Ewing), and E. batatas (Linnaeus). The larval chiggers are at present a definite pest to human beings and to animals in many areas.

The author has observed newly opened recreation areas and roadside parks which have become bad chigger areas. It is thought that this condition has been brought about by the left-over food attracting the birds, mammals, and reptiles. These hosts bring many larvae together into one place and thus cause a large population to build up.

SUMMARY

Certain phases of the bionomics of the 3 species of Eutrombicula affecting human beings in the United States were studied in relation to epidemiology and control.

The known host animals for these chiggers include 83 species of mammals, birds, reptiles and amphibians.

Descriptors
trombiculid mites
chiggers
pest

Disease/Solid Waste
Abstracts

No. DSW-8

Author

Maurice T. James

Title

The Flies that Cause Myiasis in Man

Reference

U.S. Dept. of Agriculture Miscellaneous Publi-

Doc. No. Contract No. Date issued
cation No. 631, Washington, D.C., Sept. 1947

Abstract

From the standpoint of medical entomology by far the most important insects are the Diptera or two-winged flies. Many of these, such as the haematophagous mosquitoes, the blackflies, the horseflies and deer flies, and certain muscoids, are bloodsuckers, and in this role may act as vectors of pathogenic organisms, either mechanically or through cyclic transmission. A great many other species breed in carrion, excrement, or other types of filth, from which they may carry pathogens to our food or drinking water, or directly to the human body. Still others, almost exclusively nonbloodsuckers in the adult stage, may attack the human body as larvae, thus producing the pathogenic condition known as myiasis.

The term "my(i)asis," proposed by Hope in 1840 (60, p. 258), is now in general use to indicate the condition resulting from the invasion of tissues or organs of man or animals by dipterous larvae.

Descriptors
Disease
Myiasis

Disease/Solid Waste
Abstracts

No. DSW-9

Author

Dr. James Niven

Title

Summer Diarrhoea and Enteric Fever

Reference

Royal Soc of Med. Proceedings, April 1910

| Doc. No. | Contract No. | Date issued |
|---|---|---|
|  | p 131 |  |

Abstract

We may sum up the results of this analysis as follows: Summer diarrhoea is an infectious illness. This is shown by the course of the annual wave, by the manner of its incidence on the different sanitary districts of Manchester, and by the history of individual cases. The health of infants prior to attack-in other words, the social condition- has much to do with the fatility. The summer wave is not due to dust, nor is it conditioned by any growth of bacteria in or on the soil. There is nothing to support the view that the infective organisms are of animal origin, and the connexion between privy-middens and diarrhoea goes far to prove the contrary. The disease becomes more fatal only after house flies have been prevalent for some time, and its fatility rises as their numbers increase and falls as they fall. The correspondence of diarrhoeal fatality is closer with the number of flies in circulation than with any other fact. The next closest connexion is with the readings of the 4-ft. thermometer, with which, however, diarrhoeal fatality can have no direct relation. Flies and the readings of the 4-ft. thermometer are both functions of air and surface temperatures and of rainfall. Certain facts in the life-history of the fly throw light on discrepancies arising in the decline of flies and cases. The close correspondence between flies and cases of fatal diarrhoea receives a general support from the diarrhoea history of sanitary subdivisions of the Manchester district. The few facts available for the study of the correspondence of flies and fatal cases in different subdivisions, in the course of the same year, also lend support to this view. No other explanation even approximately fits the case.

We may now consider those conditions for the conveyance of the infections of enteric fever and diarrhoea which have not been fulfilled in the arguement: (1) Are house flies present in immense numbers in houses prior to primary attacks in those of infants? In most cases they are. It is true that this is not always the case; but one does not maintain that every infant is infected through the agency of flies, though many are believed to be so indirectly who are not directly (2) Have house flies been shown to convey bacteria? They have It is unnecessary on this point to multiply references.

Descriptors

summer diarrhoea
enteric fever

**Disease/Solid Waste**
**Abstracts**

**No.** DSW- 10

**Author** McKee, J. E. ed.

**Title** 100 Problems in Environmental Health

**Reference**

| Doc. No. | Contract No. | Date. issue |
|---|---|---|
| Sec.V, pgs. 169-78 | | 1961 |

**Abstract**

This article poses research questions related to solid waste disposal: What effect does the burial of refuse have on the quality of ground water? What is the value of refuse compost in agriculture and horticulture? Compression, baling and sealing of refuse; disposal of combustible trash to sewers; control of harmful flying insects.

**Descriptors**

No. DSW-11

Author

Ralph H. Scott

Title

Disposal of High Organic Content Wastes on Land

Reference

J. Water Poll. Control. Fed, Sept. 1962

| Doc. No. | Contract No. | Date issue |
|---|---|---|
|  | p. 932 |  |

Abstract

Three so-called waste materials have been selected.... These are digested sewage sludge in liquid form, whey from cheese manufacturing, and spent sulfite liquor from sulfite pulping plants.

It appears evident that land disposal of liquid sludge may be favorable from the cost standpoint. Buildup of residential areas in closer proximity to existing sewage plants makes odor nuisances from this source a real public relations problem.

In addition to drying of whey for animal and human consumption, whey is also processed for removal of specific components, or to develop added materials of value in commerce A large portion of whey produced in the state is returned to factory patrons for stock and especially pig feed

The value of whey in the food solids it contains makes its disposal on land area an unfortunate loss.

The disposal of whey on land areas is considered a temporary expedient, although for some plants it is a yearly occurrence during the period of oversupply.

Fly breeding nuisances can result from land disposal methods unless care is taken to assure that whey solids applied to soil surfaces are soon assimilated and decomposed by soil bacteria. Whey solids may otherwise accumulate, resulting in maggot production.

Whey was applied at a rate from 5,800 to 70,000 lb/day/acre over a 9-day application cycle.

...the sandy soil absorbed the whey readily at all levels of whey application without persistent odor problems except in low spots where whey temporarily accumulated.

Whey accumulation in a low area resulted in the development of tremendous quantities of maggots which were discovered and destroyed in time to prevent an overwhelming fly problem.

Spent sulfite liquor originates from the cooking of wood ships in an acid medium to liberate wood fibers during the manufacture of sulfite pulp. The liquor consists essentially of cooking chemicals, lignin, and wood sugar.

Descriptors

waste
sewage sludge
whey
cheese manufacturing
sulfite liquor
test wells
ground water
pH
sequester
land disposal
fly breeding
spray irrigation
soil conditioner
lignin
roadbinder
BOD
iron
metals
odor nuisances
whey solids
fertilizer
sulfite liquor
wood sugar
sulfite solids
DO
manganese

Abstract (continued)

A 100-ton sulfite pulp mill may produce each operating day, a spent sulfite liquor waste of 300,000 gal containing 30 to 35 tons of BOD

Much progress has been made in recent years towards finding practical and useful outlets for spent liquor solids which total from 8 to 12 percent as collected from the blow pit. Lagooning has also been employed by a number of mills as a means of reducing pollution during the critical hot weather, low stream-flow periods A relatively large volume outlet for the material is developed through the roadbinder program carried out by the majority of mills in the State. Three sulfite mills have successfully employed land disposal methods to keep significant quantities of spent liquor from watercourses A fourth mill attempted land disposal methods with poor results.

A portion of hauling is devoted to the disposal of liquor as roadbinder for laying dust on secondary roads.

Six test wells are maintained by the mill and regularly sampled to determine any movement of sulfite liquor. Three of these wells are classed as shallow wells and three classed as deep wells. While no logs are available on the wells concerned, the logs of other wells located in the area indicate sand from 0 to 25 ft, dolomite and sandstone from 25 to 700 ft, and granite below 700 ft. So far there has been no buildup of lignin in well samples.

The Kimberly-Clark Corporation...developed land disposal methods for keeping liquor from the stream.

The undertaking, as developed for this disposal project, was based on the controlled application of sulfite liquor solids at no higher rate than 1 lb/day/sq yd. This figure was determined as a satisfactory level for significant BOD reduction through activities of soil microorganisms by Wisniewski et al.

Five test wells are sampled regularly to determine migration and movement of liquor. To date, no trace of liquor has appeared in such samples. Application rates have never approached the maximum allowable limit of 1 lb/day/sq yd or exceeded volumetrically the specified maximum disposal rate of 320,000 gal/24 hr. It appears evident that this method of application at controlled dosage rates has considerable merit and is capable of handling spent sulfite solids in a satisfactory manner through oxidation by soil bacteria.

Kansas City Star Co, Flambeau Paper Div,

... started in 1955 to develop a soil disposal area for all collectable spent liquor that could not be applied to secondary roads.

The land area selected is located on the North Flambeau River watershed below Park Falls. The region is underlaid with bedrock at an undetermined depth. The surface slope varies from approximately 3-to 3-percent grade toward the Flambeau River. It is thus believed that any underground flow of waste percolating from the disposal area must eventually reach the bedrock outcrops along, and in the stream bed.

Liquor from the holding ponds is then released through valved lines at controlled rates to the seepage and ditch areas for slow percolation to the soil and fermentation of wood sugar by soil microorganisms.

It is difficult to determine what portion of this waste may find its way back to the Flambeau River. Stream samples taken above and below the disposal area do not indicate an increase in BOD load in the stream. During an inspection of the area during the summer some field effluent was observed reaching the stream. However, this survey was made following a period of heavy rains which was doubtless responsible for the observed runoff. Under usual conditions no direct drainage from this disposal area reaches the river.

Abstract (continued)

...One project was attempted in Wisconsin which was terminated after less than satisfactory results. While as originally visualized, this disposal means was more in the nature of lagooning for absorption, or broad irrigation, the purpose was the land disposal of spent sulfite liquor.

After survey and preparation of a topographical map, it was decided to attempt a ponding experiment to absorb remaining spent liquor solids, trusting that the BOD load might be significantly reduced prior to expected sub-soil drainage of this waste back to the Wisconsin River. A seismic refraction survey of the area was completed later.

Over 50 well points were driven around the ponding area so that the direction of underground movement of the wastes could be determined.

Groundwater was sampled periodically from the test wells. Samples were checked for lignin concentration. Other determinations included occasional checks for BOD, DO, pH, iron, and manganese. These analyses showed a horizontal movement of the wastes varying from 1.5 fpd at shallow depths to 4 fpd at depths below 40 ft. Reduction in BOD was difficult to determine but appeared to approach 20 percent, which was less than anticipated.

Contrary to expectations the ponded wastes did not follow the flow line of the water table, but due to greater specific gravity followed the bedrock gradient. As a result the waste migrated under the river, the stream failing to act as a barrier. The waste followed the natural flow line indicated by the elevation of bedrock which,(See Figure 10) resulted in movement of waste into the area of mill location on the east side of the stream.

As a result of this unexpected development, all wells producing water for mill use was contaminated. These wastes have a pronounced ability to sequester metals. As a result of groundwater pollution, well waters which formerly showed less than 0.1 mg/l iron and manganese now contained 40 to 20 mg/l of these elements. Use of such groundwater supplies has necessarily been discontinued and although the wells have been pumped intermittently for the intervening period since the experimental ponding operation, no improvement has been noted.

No. DSW-12

Author

Title
Coliform Organisms as an Index of Water Safety - Progress Report, Committee on Public Health Activities

Reference
Proceedings of the American Society of Civil Engineers, Journal of the Sanitary Engineering Division, SA 6

Doc. No.

Contract No.
p. 2986

Date issued
Nov 1961

Abstract

Hepatitis syndrome developed in one or more volunteers who consumed the water in each type of treatment except in those cases where adequate chlorination inactivated the virus.

The report further said complete control of the hepatitis virus and probably other infectious agents in drinking water depends almost entirely on the disinfectant, as the virus is not eliminated or inactivated by coagulation, settling and filtration. Chlorine dosages adequate to inactivate bacterial pathogens occurring in drinking water may not be adequate for thehepatitis virus, particularly if the water has a high content of unoxidized organic material.

Investigators working with purified Coxsacki viruses have reported that free chlorine residuals of 0.27 ppm to 0.32 ppm are necessary to destroy that virus. They concluded that marginal treatment of water is not sufficient to destroy viruses even though it may reduce the coliform density to closely conform to established standards. They indicate that the coliform index should be interpreted with discretion and regard for available data on survival of viruses.

The resistance of the spores of Endamoeba histolytica to chlorine was so great that the absence of coliforms was no guarantee that the cysts were also absent. As a matter of fact, he indicated that where chlorination was the sole method of water treatment, the protection against amoebic dysentery was nil.

The ability of contaminated well water to infect human volunteers with infectious hepatitis indicated that the virus was capable of at least 10 weeks survival in Neefe's studies. It appears that, in general, enteric virus survival is longer in treated or clean water than in polluted water.

Activated sludge in amounts as low as 1,100 ppm, with 6 hr retention, removed or activated the virus to a point at which infectivity for mice was greatly reduced.

Descriptors

Adeno-virus
Amoebic dysentery
Bacteria
Coliform index
Xoxsackie viruses
Echo viruses
E. Coli
Endomoeba histolytica
Enterococci
Infectious hepetitis
Sewage
Sludge
Virus
Water

Mack, et al., noted a higher percent recovery of viruses (poliovirus, Coxsackie, ECHO) from settled activated sludge samples than from the liquid phase of sewage samples, indicating perhaps that activated sludge process may be effective in removing viruses from sewage.

Flocculation. - The removal of viruses from water by chemical flocculation appears to be the result of a metal cation-protein reaction in which a metal-virus complex is formed and aggregates to form a precipitate. The reaction is, therefore, non-specific and the results obtained with one animal virus should be applicable to other animal viruses. On the other hand, the degree of virus removal depends entirely on the efficiency of the flocculation process.

There is wide variation in virus removal efficiency of the flocculation process as studied by several workers.

Persistence of E. Coli and Enterococci. - Mallmann and Litsky showed that entercocci disapperred after 33 days from sewage treated soil, coliforms persisting throughout the 11 week study. Ostrolenk, et al., on the other hand, noted that enterococci in artificially contaminated soils and normal feces appeared to survive longer than E. coli under identical conditions.

Disease/Solid Waste
Abstracts

No. DSW- 13

Author
Paul W. Kabler

Title
Purification and Sanitary Control of Water
(Potable and Waste)

Reference
Annual Review of Microbiology, V 16, 1962

Doc. No. Contract No. Date issued
p. 127

Abstract

Although most of the streams draining inhabited regions are contaminated with human or animal feces, water-borne disease today in the United States is relatively uncommon. Pathogenic enteric microorganisms probably do not multiply in raw water sources under normal conditions. They usually disappear in a relatively short time, with the rates depending on variations in environmental conditions.

The term "enteric virus" as used here, includes all viruses which are found in quantity in human feces and in sewage. They have been classified into subgroups as: infectious hepatitis, Coxsackie A and B, poliovirus, adenovirus, and ECHO. Many years ago, Toomey et al. (40) isolated a polio-like virus from creek waters in Ohio by direct transmission to a cotton rat, and Kling (41), in Sweden, demonstrated poliovirus in well water. More recently, an unclassified adenovirus was recovered from a water sample taken from an ejector-type drinking fountain at a boys' camp (Paffenbarger et al. (42)), and enteroviruses were isolated from Hudson River water 400 feet down river from the Albany sewage plant outfall, by Kelly & Sanderson (43).

The highest densities were found in August and early September, and larger numbers of viruses occurred in samples of raw sewage than in treated sewage. Of 150 viruses isolated from sewage samples by Bloom et al. (45,46), 31 were identified as ECHO viruses, 3 as polioviruses, and 76 as Coxsackie viruses; 17 were not identified and 22 were lost.

Infectious hepatitis is currently the only viral disease of humans for which the water-borne route of infection has been generally accepted, although it is believed that person-to-person contact is the more frequent method of transmission.

Poliomyelitis infections do not appear to be related to water transmission. However, Clarke & Chang (60) reviewed two outbreaks that exhibited characteristics of water-borne disease.

Descriptors

- Acids
- Activated Sludge
- Alcohols
- Anaerobic digestion
- Aromatic ring compounds
- Carbohydrates
- Coliform organisms
- Disease
- Disinfection
- Enteric Viruses
- Fats
- Fecal streptococci
- Infectious hepatitis
- Nitrogen compounds
- Poliomyelitis
- Sewage
- Sludge-virus complex
- Stabilization ponds
- Sulfur compounds
- Trickling filters
- Waste
- Water
- Water-borne disease

Microbial metabolism is the basic mechanism in the natural purification of polluted waters. Purification of such waters by engineered biological treatment processes, i.e., activated sludge, trickling filters, or oxidation ponds is, in this respect, not essentially different from natural stream self-purification (Ettinger (63)). These processes are accomplished by the combined activitis of numerous microbial species and variants. The contributing members of the biological system are dependent on the physical and chemical composition of the menstruum and have been selected and adapted from the infinite number of microorganisms and microenvironments in nature (Kabler (64)). The transformations of carbon compounds by microorganisms were excellently reviewed by Nickerson (66) who pointed out the common pathways of oxidations for carbohydrates, alcohols, acids, fats, waxes, and aromatic ring compounds. Delwicke (67) showed that the degradation of nitrogen compounds would invariably be accomplished by hydrolysis of proteins or other complex nitrogen molecules and would result in the eventual decomposition of the lower molecular weight residues. Diverse microorganisms participate in degradation of sulfur compounds, many of which command attention as they produce materials having objectionable odors or cause corrosion of industrial equipment (Starkey (68)). The two principal sulfur products formed are sulfate under aerobic conditions and sulfide under anaerobic conditions.

Biological treatment by trickling filters, activated sludge, anerobic digestion, or stabilization ponds will markedly reduce the numbers of pathogenic enteric bacteria, viruses, parasites, and tubercle bacilli in sewage, but the resulting effluents will contain some of each kind of microrganism present in the raw sewage (Kabler (75).

Using a laboratory model activated sludge unit, Clarke et al. (77) removed approximately 90 per cent of type I poliovirus and about 98 per cent of Coxsackie A9 virus from a sewage suspension. Since the mechanism of removal of virus appeared to be an adsorption phenomenon, it was reasonable to infer that other enteric viruses would also be removed from sewage by such treatment. Only a small percent of the virus was recovered, indicating that the sludge-virus complex was extremely stable or that most of the virus was in some manner inactivated.

1. Woodward, R. L., J. Am. Water Works Assoc., 49, 1068 (1957).

2. Fraser, M. H., Reid, W. B., and Malcolm, J. F., J. Appl. Bacteriol., 19, 301 (1956).

Disease/Solid Waste
Abstracts

No. DSW-14

| | | |
|---|---|---|
| Author | | |
| Richard L. Woodward | | |
| Title | | |
| Review of the Relation of Water Quality | | |
| and Simple Goiter | | |
| Reference | | |
| J. American Water Works Association | | July 1963 |
| Doc. No. | Contract No. | Date issued |
| | p. 887 | |

Abstract

That goitrogenic materials are present in some drinking waters seems beyond question. This is not to deny the major role of iodine deficiency as a cause of goiter, but simply to emphasize that other factors may contribute.

The common finding that boiling of the water eliminates the goitrogen suggests that a heat-labile chemical may be involved. The possibility that an infectious agent is involved has been virtually eliminated by the epidemiologic and experimental observations. Efforts to isolate an agent capable of producing goiter have never succeeded. It is certainly not difficult to conceive that materials similar to the known antithyroid drugs could be present in wastes or produced as degradation products of these wastes.

Most of the information pointing to a relationship between goiter and drinking water is epidemiologic, and epidemiologic studies cannot be expected to determine which constituents in water are significant.

Knowledge of the nature of organic-chemical pollutants in water is very sketchy, and knowledge of their physiologic significance is even more so.

Descriptors
Goiter
Goitrogenic materials
Mineral pollutants
Organic chemical pollutants
Wastes

**Disease/Solid Waste**
**Abstracts**

No. DSW- 15

**Author** H.R.Wolfe et al

**Title** Health Hazards of Discarded
Pesticide Containers

**Reference** Archives of Environmental
Health,

| Doc. No. | Contract No. | Date. issue |
|---|---|---|
| Vol. 3, pgs. 45-51 | | Nov. 1961 |

**Abstract**

The proper disposal of various types of "empty" pesticide containers continues to be a problem in agricultural areas and in some public health vector control projects. These discarded containers constitute a potential health hazard, mainly to children. The seriousness of this hazard is in direct relation to its propinquity to areas frequented by children.

These so-called "empty" containers are never completely empty. Johnston reported a fatal poisoning case involving a 9-month old child who played with a discarded can containing a pasty mixture of DDT and parathion.[6] Johnston also cited another incident in which 2 children were found playing with sacks that had contained 25% water-wettable powdered parathion. One of these children developed mild symptoms of poisoning and had a depressed blood cholinesterase level. The other child showed no signs or symptoms of poisoning. McGee et al. described the fatal poisoning of a child who played in a shed covered with metal sheets made from a drum that had contained toxaphene.[7]

Another group of persons who have contact with discarded pesticide containers are workers at garbage dumps and landfill areas. Mail et al. studied the exposure to insecticides of employees at a city landfill.[8] The results of chemical analyses on blood, urine, alcoholic handwashes, and exposure patches indicated that the exposure of these employees to parathion was minimal. Mail and his coworkers concluded that disposal of containers for organic phosphorus insecticides at a city landfill could be done with safety to personnel when recommended precautions were followed. For the safety of scavenging persons who might be tempted to use the containers, empty pesticide containers should be consigned to a landfill only if immediate crushing and covering of the containers as soon as they are delivered can be assured.

**Descriptors**

disposal
pesticide
containers
children
fatal poisoning
pesticide containers
DDT
parathion
toxaphene
garbage dumps
workers
landfill safety
scavenging

Disease/Solid Waste
Abstracts

No. DSW-16

Author
N. A. Clarke, G. Berg, P. W. Kabler and
S. L. Chang

Title

Human Enteric Viruses in Water: Source,

Survival and Removability

Reference

Advances in Water Pollution Research V. 2

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| (TD 420 IN 8 V. 2) | | 1964 |

Abstract

The past decade has witnessed the discovery of nearly 100 new enteric viruses (Table 1), largely through the use of tissue cultures. All of these "new" viruses are excreted in the feces of infected individuals and can be readily demonstrated in urban sewage, particularly in the late summer or early fall.

The number of recognized water-borne outbreaks of enteric virus disease is not large, although infectious hepatitis is probably the most frequent water-borne disease in the United States today. The data on coliform organisms reported by the New Delhi water treatment plant would indicate that under unusual circumstances the coliform index may be unreliable for judging the adequacy of modern water treatment processes for destroying or removing the virus of infectious hepatitis and perhaps other enteric viruses. No clearly defined outbreaks of water-borne enteric virus disease have been reported with other members of this virus group, although suspect water-borne outbreaks of poliomyelitis have been reported,[2,3] and three outbreaks of clinical disease due to adenoviruses have been associated with swimming pools.[4,5,6]

A considerable literature has accumulated on the isolation of enteric viruses from the feces of children or from sewage, but unfortunately it offers very little quantitative data. There is essentially no information available on the occurrence of enteric viruses in polluted surface waters.

It must be pointed out that while essentially everyone discharges coliform bacteria and streptococci in feces, the excretion of enteric viruses in feces by apparently healthy individuals is largely confined to children under age 15.[16]

The relative enteric virus density to coliform density in human feces is about 15 virus units for every million coliforms (a 1 to 65,000 ratio).

The average enteric virus density in domestic raw sewage is probably about 500 virus units per 100 ml, and in polluted surface water not more than 1 virus unit per 100 ml.

Descriptors

Bacteria
Enteric
Human feces
Survival
Viruses
Water

These values, of course, would be subject to wide variation and radically changed during a virus disease epidemic.

Bacteria survival times were related directly to the degree of pollution of the water, longest survivals occurring with the greatest pollution.

Table 3. Isolations of Enteric Viruses from Various Locations in a Sewage Plant*

| Sampling location | % of samples positive |
|---|---|
| Influent | 32.6 |
| Raw sludge | 38.1 |
| Primary tank effluent | 23.8 |
| Activated sludge tank | 11.1 |
| Activated sludge return | 6.7 |
| Final settling tank | 5.3 |
| Final, unchlorinated effluent | 9.8 |

*From Bloom et al. See Ref. 7.

Observation would appear to indicate that suspended solids, colloidal material and also perhaps toxic substances play a role in the reduction of virus as raw sewage is treated by activated sludge. The activated sludge undoubtedly removes most of this sewage-virus complex, in addition to most of the remaining "free" virus.

In summary, it appears that primary sewage treatment is relatively ineffectual in removing virus from sewage; that activated sludge treatment will remove 90 per cent or more of the virus; but that if a virus-free effluent is sought, additional treatment (disinfection) must be used.

## SUMMARY

A survey has been conducted to ascertain the problem posed by human enteric viruses in water and sewage. The efficacy of current water and sewage treatment processes in removing or destroying these agents in water has been examined and the following points developed:

1. The average enteric virus density in domestic sewage is probably about 500 virus units per 100 ml, and in polluted surface water not more than one virus unit per 100 ml. The ratio of enteric virus density to coliform density in human feces is about 15 virus units for every million coliforms.

2. The survival times of enteric viruses and indicator bacteria in water depend to a great extent on the nature of the water. Viruses appear to survive longer in water that is relatively unpolluted or grossly polluted. Indicator bacteria survival times in surface waters appear to be directly related to the pollution of the water; longest survivals occur in water with the greatest pollution. Additional data are needed before any generalizations can be made on the relative survival times of viurses and bacteria in water.

3. Recent studies indicate that the activated sludge process will remove 90-98 per cent of enteric viruses in raw sewage. The fate of virus removed by activated sludge treatment remains unexplained.

4. The flocculation process, when properly applied using either alum or ferric salts, can remove 95-99 per cent of Coxsackie A2 virus from water in a single-stage flocculation, or more than 99 per cent in a double-stage operation. Virus removal parallels removal of bacteria and turbidity.

5. Hypochlorous acid is highly effective in inactivating viruses in water. The rate of inactivation is dependent on the specific virus, pH, temperature, and contact time. Polioviruses, Coxsackie viruses, and the virus(es) of infectious hepatitis appear to be more resistant to hypochlorous acid than are coliform or enteric pathogenic bacteria. Type 3 adenovirus appears to be more sensitive to hypochlorous acid than E. coli. Combined chlorine is far less viricidal than hypochlorous acid.

6. Iodine is highly efficient in destroying enteric viruses in water. Hypoiodous acid appears to be a more effective viricide than elemental iodine. Elemental iodine and hypoiodous acid, because they do not readily react with ammonia, may prove useful water disinfectants.

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Disease/Solid Waste
Abstracts

No. DSW-17

Author

Richard L. Woodward

Title

Discussion of article (Abstract no. DSW-19)

Reference

J. American Water Works Association

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | p. 1272 | Oct. 1962 |

Abstract

Cities with filtered water supplies show higher average morbidity rates than do cities with ground water supplies. This suggests that hepatitis transmission may be through the water.

Descriptors

Ground water
Infectious hepatitis

Disease/Solid Waste
Abstracts

No. DSW-18

Author
Sally Kelly and Wallace W. Sanderson

Title
Density of Enteroviruses in Sewage

Reference
J. Water Pollution Control Federation

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| V. 32, no. 12 | p. 1269 | Dec. 1960 |

Abstract

The density of enteroviruses in sewage is low in comparison with that of coliform bacteria, the indicator of sewage pollution. This suggests that even at the height of the enterovirus season the population is discharging enteroviruses in small amounts. The low densities are probably not the result of inactivation of viruses en route to the plant since detention by primary treatment does not invariably affect the density. The densities of Salmonella and other bacterial pathogens in sewage are reported by some to be higher than (11) (12) and by others to be the same as (13) (14) those found for the enteroviruses.

The presence of minimum densities of virus in the winter months indicates that there is a small constant reservoir of enterovirus infection in the population regardless of season.

The density of plaque-forming enteroviruses in sewage. Highest densities were found in August and early September and in samples of raw rather than treated sewage. The enteroviruses isolated as PFU were identified as strains of Coxsackie, ECHO, and polioviruses. The extent to which certain components of sewage were concentrated by the swab was demonstrated.

Descriptors
Enteroviruses
Sewage

**Disease/Solid Waste**
**Abstracts**

No. DSW- 19

**Author** Gordon G. Robeck, et al

**Title** Effectiveness of Water Treatment Processes in Virus Removal

**Reference**
J. American Water Works Association, Oct. 1962

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| pgs. 1275-1292 | | Oct. 1962 |

**Abstract**

Discussion: There has been considerable speculation recently about the possible movement of viruses through the ground due to their small size,[9,10] and outbreaks of viral disease have been traced to polluted well water.[11,12] The trouble, however, was usually traceable to fissured rocks or gravelly soil that should not have been used for waste disposal and also as a potable water source.

In these tests, the virus did not pass in any appreciable number through a 2-ft clean sand bed, although the pores were 100 or 1,000 times larger than the virus. Die-off of 5 to 10 per cent per day will always occur, as the organism cannot multiply away from living host cells. Then too, other competing organisms in soils might cause a rapid die-off of viruses. It thus appears that well-packed sandy soil is a good protector of ground water providing one uses proper design criteria and dosing rates.

Coagulation and filtration are really one process. The floc age and strength, for instance, are more important than its size or density if the virus and turbidity are to be retained by the filter. Though smaller than coliform organisms, the poliovirus organism is removed by flocculation and filtration with about the same efficiency as coliforms.

Summary and Conclusions: Small-scale pilot plants were used to study the removal of poliovirus Type I from water as it passed through unsaturated or water-saturated sand at ground water movement rates and through a flocculation-filtration process at rapid rates. Some erratic results with rapid rates indicate that more testing is necessary to resolve design and operating problems with any modified treatment processes.

The principal findings on both phases of work over a 20-month period were:

**Descriptors**

water
treatment processes
virus removal

1. Two feet of clean, well-packed sand removed poliovirus from water that was flowing at less than 4 ft per day, and the percentage removed gradually decreased until most of the organisms went through at rapid filtration rates.

2. If a low but well-mixed dose of alum was fed just ahead of the filters operated at 6 or 2 gpm/sq ft, more than 98 per cent of the viruses were removed by 16 in. of coarse coal on top of 8 in. of sand. Sand alone did as well, but filter runs were shorter than they were with the mixed media.

3. If the alum dose was increased and conventional flocculators and settling were used, the removal was increased to over 99 per cent.

When a turbid water was treated, a floc breakthrough was usually accompanied by an increase in virus penetration even though the finished water turbidity remained below 0.5 Jackson unit. When relatively clear water was treated, the virus penetration increased without a corresponding increase in filter effluent turbidity. This was especially true when 5 instead of 10 ppm of alum was used.

Discussion - Herbert O. Hartung: The article by Robeck, Clarke, and Dostal contributes materially to the growing evidence that the public water supply can be processed to remove or inactivate viruses of public health significance. This evidence is consistent with epidemiological studies of waterborne diseases which indicate that viral infections from the use of properly treated public water supplies are unlikely at thepresent. Both laboratory and epidemiological studies show that the possibility of waterborne viral outbreaks seems to be linked to the presence of gross viral pollution in raw-water sources, and to the absence of reliable water treatment procedures at the local water treatment plants for reducing viruses below infectious levels. All of these studies indicate, however, that under circumstances of gross raw-water pollution and some existing water treatment methods, a bacteriologically safe water may not be virally safe.[3]

Chlorination under controlled conditions is also effective for viral removal. However, chlorination for bacteria disinfection may not always be a dependable viricide. Free chlorination is considerably more viricidal than combined chlorine.

The Task Group on Viruses in Water recommends future studies to show the effect of lime softening and excess lime softening on virus removal.

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**Disease/Solid Waste Abstracts**

**No.** DSW- 20

**Author** F. F. Dias

**Title** Studies in the Bacteriology of Sewage

**Reference**

Jrl. Indian Institute of Science

| **Doc. No.** | **Contract No.** | **Date issue** |
|---|---|---|
| v. 45, p. 36-48 | | 1963 |

**Abstract**

Sewage by virtue of its nature and origin, acts as a repository for micro-organisms of differnt types. However, all the microorganisms that enter sewage do not survive and thus sewage soon acquires a characteristic flora of its own. The nature of this flora will be conditioned by the charactef of the sewage, e.g., a specialised industrial waste will have a flora different from a purely domestic sewage. In the various biological methods of sewage purification this selection of types goes a step further with the result that a highly specialised flora, able to function properly only under the conditions that have favoured the selection, develops.

Another objective set forth in this study was to discover, if possible, bacteria exclusive to the human intestine. If successful the presence of such bacteria would prove useful as indices of faecal pollution of water, foods or crops grown in sewage farms.

A large number of sludges and effluents on examination showed that whereas activated sludge and the effluent therefrom contained a preponderance of chromogenic and fluorescent bacteria (even more than in raw sewage, thus indicating their role in the activated sludge process) in septic tank sludge and effluent opaque white colonies were the dominant aerobic flora. The samples of septic sludge and effluent examined however revealed a large number of moulds.

The aerobic bacterial population of activated and septic sludges were also enumerated (Table VII). That the septic sludge contained a smaller number of coliforms than activated sludge was surprising, as these being facultatively anaerobic, a higher population might be expected to persist under the anerobic conditions. However, that the coliforms from only a small portion of the total population lends support to the view that in sewage stabilisation bacteria other than the coliforms play an important part.

**Descriptors**

sewage
faecal pollution
water
foods
crops

**Disease/Solid Waste Abstracts**

No. DSW-21

**Author**

N. A. Clarke, R. E. Stevenson, et al.

**Title**

Removal of Enteric Viruses from Sewage by Activated Sludge Treatment

**Reference**

J. of Pub Health, Vol. 51 (1961) No. 8,

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| pp. 1118 | | |

**Abstract**

The data presented in this paper indicate that the activated sludge process is an effective method for removing at least two different enteric viruses from sewage. The ultimate fate of the adsorbed or inactivated virus was not determined, although a number of various technics were tried in an attempt to release virus presumed to be adsorbed to the sludge. Only a very small percent of virus could be recovered, indicating that the sludge-virus complex is extremely stable or that most of the virus is in some manner inactivated.

The bench model continuous-flow activated sludge unit used in these experiments was operated with a six to seven hour retention time and was seeded with activated sludge in amounts ranging from 200 to 4,000 ppm, expressed as volatile solids. Excepting with the 200 ppm seed, the unit removed approximately 90 percent of Type 1 poliovirus and about 98 percent of Coxsackie A9 virus. Coliform and fecal streptococci removals averaged about 97 and 96 percent, respectively. It was also demonstrated that about a 60 percent reduction of Type 1 poliovirus could be achieved by feeding sewage and virus through a bench model unit containing no activated sludge. This indicates that the suspended solids and colloidal material, and perhaps toxic substances, in raw sewage also play a role in the reduction of virus as virus is treated by the activated sludge process.

The only study of which we are aware in which effluent from activated sludge treatment plants has been examined for virus was reported by Mack, et al (6). Their report showed that enteric viruses could be isolated from unchlorinated effluents with considerable regularity. ...Although activated sludge does remove 90 percent or greater of enteric viruses added to sewage, it must be coupled with additional treatment (disinfection) if a virus-free effluent is sought.

**Descriptors**

| | | |
|---|---|---|
| enteric viruses | sewage | sludge treatment |
| poliovirus | Coxsackie virus | |

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**Disease/Solid Waste**
**Abstracts**

No. DSW-22

Author

W. N. Mack, J. R. Frey, et al

Title

Enterovirus Removal by Activated

Sludge Treatment

Reference

J. Water Pollution Con. Fed., Nov. 62 p. 1133

Doc. No. Contract No. Date issued

Abstract

The present studies focus attention on two questions: (a) During sewage treatment what proportion of the total virus concentration was removed by the various steps in the process? (b) If all viruses were not inactivated, what viruses would be found in the chlorinated effluent?

The results from...bench model experiments seem to indicate that in order to recover viruses from sewage, very large amounts of virus must be present before being detected. This is probably the case and the viruses isolated in the current study probably represent only a small fraction of the original virus concentration present in the sewage.

In light of the knowledge that presently used chlorine concentrations do not destroy all of the enteroviruses, higher concentrations and longer holding periods are needed to destroy the large group of virus pathogens in domestic sewage.

Using monkey kidney epithelial cell cultures, viruses were isolated 54 times (8.8 percent).

Viruses were isolated six times (10.8 percent) from 55 sludge samples. Three times viruses were isolated from pooled and concentrated pad and dip samples collected from the chlorinated effluent.

The percentage of virus isolations indicated that there was a progressive decrease in virus content of the sewage as it was processed through the plant.

Plaque counts were done to determine the concentration of virus particles in each positive sample. These data showed that there actually was a progressive increase of virus particles per unit volume as the sewage was processed.

Chlorination produced a 92-to 95-percent reduction of virus particles in the final effluent.

Descriptors

sludge
chlorination
chlorinated
sewage
sewage treatment
effluent
virus concentration

**Disease/Solid Waste Abstracts**

**No.** DSW- 23

**Author** Robert J. Anderson,

**Title** The Public Health Aspects of Solid Waste Disposal

**Reference** Public Health Reports

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| Vol. 79, No. 2, pgs. 93-96 | | Feb. 1964 |

**Abstract**

It is necessary to remind ourselves, I believe, that disposal of solid wastes is fundamentally a health problem. The most prevalent disposal system of serious danger to health is, of course, the open dump, with its flies and rats. Typhoid fever, cholera, summer diarrhea, dysentery, tuberculosis, anthrax, and opthalmia, as well as intestinal worms, can be transmitted by flies. The control of fly breeding through adequate garbage collection, elimination of garbage dumps, and proper disposal of feces are the first rules for the control of typhoid fever (2). In addition, plague, murine typhus fever, leptospirosis, rat-bite fever, trichinosis, food poisoning, richettsial pox, lymphocytic chorio-meningitis, and rabies can be transmitted by rats and mice, while malaria, yellow fever, dengue, mosquito-borne encephalitis, and filariasis can be transmitted by mosquitoes.

Poor refuse handling commonly provides food for flies, cockroaches, and domestic rodents. Open cans and bottles catch and hold water in which mosquitoes can breed so that many individual citizens unknowlingly but actively encourage the proliferation of these disease-carrying pests. Many experts in this field have pointed out that garbage is usually the chief source of food for rats in urban areas (3). Many rat infestations are supported entirely on improperly stored garbage. Limitations on food, water, or harborage are the only determinants to the size of a community's rat population.

One scientist (8) noted that burning dumps cause air pollution problems in about 25 percent of the urban communities of the country. Water pollution is also becoming a serious factor in this picture. Wherever refuse is deposited on land, the impact on surface waters or subterranean aquifers may be significant.

**Descriptors**

Waste
typhoid fever
cholera
summer diarrhea
dysentery
tuberculosis
anthrax
opthalmia
intestinal worms
plague
murine typhus fever
leptospirosis
rat-bite fever
trichinosis
food poisoning
richettsial pox
lumphocytic chorio-meningitis
rabies
rats
mice
malaria
yellow fever
dengue
mosquito-borne encephalitis
filariasis

## References

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**Disease/Solid Waste**
**Abstracts**

**No. DSW-** 24

**Author**
Conference Report

**Title**
Solid Research Needs for Solid Wastes

**Reference**
Public Health Reports

| **Doc. No.** | **Contract No.** | **Date issue** |
|---|---|---|
| Vol. 79, No. 2, pgs. 97-100 | | Feb. 1964 |

**Abstract**

The volume of solid waste has grown more rapidly than the population at the same time that available economic space for waste disposal has declined. Management of solid wastes has received a negligible amount of study. The total amount of research in nonradioactive solid wastes management is limited to that supported by $200,000 in grants by the Public Health Service and the studies that other government agencies, universities, private enterprise, and professional associations sponsor. Most of the crises in waste management arise from the need for sites for sanitary landfills. The daily per capita load of dry solid wastes consists of 200 grams discharged to the land, 865 grams to the streams, and 1,465 grams to the atmosphere in the form of particles and fumes, exclusive of carbon dioxide, water vapor, and other natural components of air. The desideratum is to convert wastes into useful and marketable forms. Techniques for combustion which restrain fly ash and noxious fumes and diminish the weight of the load by 90 percent. Better methods of disposing of residue and junk. Basic research was the main topic of the conference. Many systems, he said have been under-designed on the assumption that the load would amount to no more than 3 pounds per capita, instead of the figure of 4 pounds derived from more thorough methods of measurement. Collection and carrying costs amount to about 85 percent of the budget for handling solid wastes.

The heterogeneity of refuse, the variety and dispersion of sources, and seasonal and geographic variations in content, volume, and characteristics such as moisture are amplified by technological changes.

Another nontechnical direction of investigation: the social, psychological, and political aspects of solid waste management.

**Descriptors**

In conclusion, the conferees agreed that research in solid waste management calls for joint enterprise by various disciplines, many diverse agencies of government and industry, and several combinations of governmental jurisdictions.

Disease/Solid Waste
Abstracts

No. DSW-25

Author

Sally M. Kelly, Mary E. Clark & Marion B. Coleman

Title

Demonstration of Infectious Agents in Sewage

Reference

Amer. J. of Pub. Health, V.45 (11):1438-46,

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Nov. 1955 | | |

Abstract

The three studies offer ample evidence also of the disturbing fact that sewage treatment, while complying with existing standards, may not control pathogenic agents to the extent that receiving streams can be ignored as potential sources of infection.

Descriptors

**Disease/Solid Waste Abstracts**

**No.** DSW- 26

**Author** Willard H. Wright

**Title** Studies on Trichinosis

**Reference** Public Health Reports

| **Doc. No.** | **Contract No.** | **Date issue** |
|---|---|---|
| V. 55, p. 1069-77 | | Jun. 1940 |

**Abstract**

Some time ago, the writer (1) reported an incidence of trichinae of 16.3 percent in 3,000 diaphragm examinations in the National Institute of Health and summarized the findings in other post-mortem surveys in the United States which indicated an incidence of trichinae of 18 percent in 3,494 examinations when due allowance is made for differences in the techniques employed. Since that time, Walker and Breckenridge (2) have reported finding the parasite in 33 of 100 persons coming to necropsy in Birmingham and Tuscaloosa, Ala.; Evans (3) has reported on incidence of 36 percent in 100 cases at Cleveland, Ohio; Hood and Olson (4) in Chicago found trichinae in 5.77 percent of 208 diaphragms examined by both the digestion and microscopic methods; while Sawitz (5) has reported a finding of trichina infection in 7 percent of 200 additional diaphragms examined at New Orleans. Previous surveys showed that approximately 1 in every 6 persons examined was infected with the parasite.

We are now engaged in a survey designed to determine the incidence of the parasite in persons residing on farms or in villages of 1,000 population or less. To date, only 5 or 4.1 percent, of 122 such persons have been found positive for trichinae.

It is not out of order to hazard an opinion that the relatively large number of garbage-fed hogs going on the market in cities may represent the answer to the increased exposure to trichinosis faced by the city dweller.

Hall (6) has aptly pointed out the role of the hog fed on raw garbage as a source of human trichinosis. Schwartz (7) has reported further on the examination for trichinae of swine maintained on different types of feed. Of 2,847 diaphragms from hogs that had been fed garbage as collected, 286, or 10 percent, were infected with trichinae. Of 3,799 diaphragms from so-called grain-fed hogs, 40, or

**Descriptors**

trichinosis
garbage
disposal
methods
spread

1 percent, were infected with trichinae. Schwartz (8) had previously reported on the examination of 1,860 swine fed on cooked garbage, of which only 0.59 percent were infected with trichinae. At the present time the evidence is overwhelmingly in support of the view that the hog fed on uncooked garbage is the chief source of human trichinosis.

In the aggregate, American municipalities either directly or indirectly are probably the largest feeders of raw garbage to swine and would therefore appear to be chiefly responsible for the dissemination of trichinosis. Many hogs maintained on municipal garbage are slaughtered locally, and many cities are thus contributing indirectly to the ill health of their own citizens. We have been informed that many garbage feeders avoid marketing their hogs in federally inspected packing plants in order to obviate price differentials resulting from condemnations under Federal inspection for disease conditions, other than trichinous, which are common in garbage-fed hogs. In uninspected plants, trichinous pork may go into products customarily eaten raw by the consumer, thus providing very dangerous avenues of infection.

Geographical areas in which many hogs are raised on garbage are the areas having the most clinical trichinosis.

## References

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(8) (Schwartz, Benjamin.) In Annual Report of the Bureau of Animal Industry, 1937, pp. 57-64.

**Disease/Solid Waste Abstracts**

**No.** DSW-27

**Author** Alan C. Pipkin

**Title** Experimental Studies on the Role of Filth Flies in the Transmission of Endamoeba Histolytica [1,2,]

**Reference**
American Journal of Hygiene

| **Doc. No.** | **Contract No.** | **Date. issue** |
|---|---|---|
| V. 49, p. 255-75 | | 1949 |

**Abstract**

Although the experiments of earlier workers are not to be discounted it is thought that modern cultivation techniques offer more critical and exact methods of evaluating viability.

From these experiments a number of conclusions may be drawn, as follows: As far as the species of flies tested is concerned, external carriage of trophozoites or cysts of E. histolytica probably plays no important role in the transmission of amebiasis except in cases of gross neglect of sanitary rules. Trophozoites of E. histolytica seldom weather a trip down the alimentary canal of the fly species tested. Cysts show little difference in their subsequent viability after exposure to cystidal effects at the same level of the alimentary tracts of the 5 species of flies tested. Culturable trophic stages were not recovered for periods longer than 25 minutes after feeding in any of the species. Recognizable or subsequently culturable trophozoites of this parasite were not recovered from the vomitus of any of the 5 species tested after periods of 18 or 19 minutes, respectively, following feeding. It seems safe to conclude that, although not impossible under usual circumstances, the ingestion of trophozoites by flies and subsequent deposition in their vomitus on human food or drink is not of great epidemiological importance. In general, the larger species of flies had absolute maximum and mean maximum times of depositing subsequently culturable cysts in the vomitus. Some species deposited significantly greater numbers of vomit drops which contained subsequently culturable cysts than did others. The passage of viable cysts of E. histolytica in the fly vomitus 64 minutes after initial ingestion and in fly feces 4 hours and 20 minutes after ingestion, offers a potential natural method of transmission under conditions commonly occurring in backward and rural sections, which might plausibly explain community amebic infections.

**Descriptors**

flies
endamoeba histolytica
trophozoites
cysts

**Disease/Solid Waste Abstracts**

**No.** DSW- 28

**Author** Joseph L. Melnick et al

**Title** Seasonal Distribution of Coxsackie Viruses in Urban Sewage and Flies

**Reference**
American Journal of Hygiene

| Doc. No. | Contract No. | Date. issue |
|---|---|---|
| V. 59, p. 164-84 | | 1954 |

**Abstract**

In the present study, virus was obtained from flies in residential areas where no source of contamination was obvious. However, from experiments with laboratory-infected flies, no evidence was obtained for virus multiplication within flies, even though it was found to persist within them and in their excreta for 1 or 2 weeks (16).

Summary: Consecutive tests for up to 4 years for Coxsackie viruses in urban sewage and flies have been carried out in 6 states: Arizona, Connecticut, Kansas, Michigan, New York, and West Virginia. A total of 1,929 tests has been carried out, of which 269 yielded virus.

Viruses appeared in some of the specimens collected in the summer and fall, and then disappeared during the winter and spring. Virus was detected in the community during the cold months but was not widely disseminated, for it was only a rare winter specimen that yielded virus. The recovery of Coxsackie viruses was more regular from sewage than from flies. The long persistence of virus for several months in a residential area, or its reappearance after a short period, may be due to the serial dissemination of new types of virus rather than to recurring waves of infection by the original virus.

Virus has been found in the influent and effluent flow at sewage disposal plants. However, on some occasions it has not survived in detectable amounts the trip to the plant, for it was recovered from several residential areas in Topeka when the sewage at the disposal plant was negative.

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16. Melnick, J. L., and Penner, L. R. The survival of poliomyelitis and Coxsackie viruses following their ingestion by flies. Jour. Exper. Med., 1952, 96: 255-271.

**Descriptors**

coxsackie
viruses
sewage
flies
Coxsackie viruses

**Disease/Solid Waste**
**Abstracts**

No. DSW- 29

**Author** S. D. Faust

**Title** Pollution of the Water Environment by Organic Pesticides

**Reference** Clinical Pharmacology and Therapeutics

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| V. 5 | p. 677 | Nov.-Dec. 1964 |

Abstract

Man is exposed to organic pesticides in his water environment through their use in the control of aquatic weeds, insects, and trash fish; percolation and runoff from agricultural lands; drift from aerial and land applications; and discharge of industrial waste waters. Chemical and biologic evidence indicates that most surface waters of the United States, in general, are polluted with the chlorinated hydrocarbon insecticides. In specific and localized situations, ground and surface waters have been polluted with the herbicide, 2,4-D. These organic pesticides are routed to man through drinking water and indirectly through edible fish. The general evidence suggests that adsorption on solid surfaces, biologic and chemical degradation, hydrolysis, uptake, retention, and release by biologic systems, and chemical precipitation reactions do not eliminate organic pesticides quickly from water. Organic pesticides affect drinking water quality through off-tastes and off-odors. Since the concentrations of several organic thiophosphates and 2,4-D producing tastes and odors are far below subtoxic levels by factors ranging from 17 to 113,000, threshold taste and odor levels can be used to establish drinking water standards with the appropriate safety factors. Organic pesticides do not appear to represent a health hazard, chronic or acute, to man at the microgram per liter and milligram per liter concentrations believed to be in ground and surface waters at the present time.

Descriptors

Pollution
water
organic pesticides
ground and surface waters
edible fish
organic thiophosphates
2,4-D

**Disease/Solid Waste**
**Abstracts**

No. DSW- 30

**Author** Zofia Buczowska

**Title** Tubercle Bacilli in the Sewage and in Sewage-Receiving Waters

**Reference** Bulletin of the Institute of Marine Medicine in Gdansk

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| V. 16, p. 49-56 | | 1965 |

**Abstract**

Conclusions: Sedimentation and biological purification of sewage did not remove tubercle bacilli which survived in the sewage during the flow to the treatment plant. Disinfection of hospital and sanatorium sewage by method of incontinuous chlorination in small, uncontrolled treatment plants proved ineffective. Contamination of domestic sewage derived from an area where the morbidity index of active tuberculosis among the population is 124/10,000, although considerably smaller than the contamination of hospital sewage, confirms the validity of hygienic objections to the use of sewage for the irrigation of forage-crop fields. Slaughterhouse wastes may be regarded as contaminated if they are derived from slaughtering of cattle with a high percentage of tuberculosis infections. The disposal of sewage contaminated with tubercle bacilli, after ineffective disinfection, into open ditches is dangerous as it may become the source of infection to the cattle grazing in the nearby meadows.

Descriptors

**Disease/Solid Waste Abstracts**

**No.** DSW- 31

**Author** Shih Lu Chang

**Title** Viruses, Amebas, and Nematodes and Public Water Supplies

**Reference** Jrl. American Water Works Association

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pgs. 288-296 | | Mar. 1961 |

**Abstract**

No matter where one goes in this country, he can drink a glass of municipally supplied water without fear of contracting bacterial diseases. Of all the peacetime hepatitis outbreaks, only two were associated with the use of municipal water supplies; the others involved chlorinated or unchlorinated small supplies.

It appears that waterborne outbreaks of infectious hepatitis resulting from the use of municipally treated water supplies are unlikely. These outbreaks may occur, however, if the raw source is so grossly polluted by domestic sewage that the concentration of viral agents is such that it cannot be reduced below infectious levels by the treatment procedures available to the local water system.

Enteroviruses--comprising 3 types of poliovirus, 30 types of Coxsackie virus, and 24 types of ECHO virus--are so called because they multiply in the human intestine and are discharged chiefly in the feces. Of all the enterovirus infections recorded, only two waterborne outbreaks have been reported, both of poliomyetitis.

The complete absence of waterborne outbreaks of the Coxsackie and ECHO virus infections is certainly an extraordinary phenomenon. Although adenoviruses belong to the respiratory group of viruses, they apparently multiply in the human gut and are found, therefore, in significant amounts in feces and recovered in sewage. Waterborne adenovirus infections have not been reported. To date, only four waterborne outbreaks of amebiasis have been recorded in the literature.

Parasitic nematodes: Municipal water supplies are not known to be involved in spreading infections by any nematode. But small rural supplies in certain endemic areas could carry hookworm or strongloidal larvae washed into the water from infected soil. These supplies constitute a mode of transmission of minor importance as compared to the soil itself. The findings of a recent survey of

**Descriptors**

viruses
amebas
namatodes
water supplies
hepatitis
infectious hepatitis
enteroviruses
Coxsackie virus
ECHO virus
poliomyelitis
epidemic
adenoviruses
amebas
endameba histolytica
amebiasis
*Salmonella* bacteria
*Shigella* bacteria

22 city water supplies for free-living nematodes and amebas[13] indicated that the nematodes are relatively common in municipal water supplies from surface sources. Of the 22 treated supplies examined, 16 contained nematodes. Being free living nonpathogenic to man, these nematodes themselves have no health significance. However, two species were capable of ingesting Salmonella and Shigella bacteria and Coxsackie virus. Of the ingested pathogens, 6016 per cent survived for 1 day; 0.1-1 per cent survived for 2 days. The ingested pathogens were protected to the extent that they all survived even when 90 per cent of the carrier worms were immobilized.

On the basis of these findings, it was thought that nematodes of aerobic sewage treatment origin could serve as carriers of human enteric pathogens. Under normal conditions, however, the chances of nematodes ingesting the pathogens in the treatment plant and being carried by thepolluted water through the water system in a day are so small that the possibility must be considered as very remote.

The incidence of infectious hepatitis in the United States has been cyclic since the disease was included, in 1952, in the list of diseases published in the USPHS Morbidity and Mortality Weekly Reports. In the year ending Sept. 3, 1960, nearly 34,000 cases were reported. The great majority of cases were sporadic and of undetermined origin. At the present, epidemiologic evidence points to personal contact as the major route of transmission.

The fact that the ratio of cyst density to that of coliform organisms in sewage (estimated on the basis of a 10 per cent cyst carrier rate) is approximately 1:100,000[21] and that cysts tend to settle out in sewage, sewage effluent, and water[22] may very well explain the unlikelihood of waterborne amebiasis associated with municipal water supplies using even heavily polluted water as their raw source.

Endameba histolytica: All the outbreaks were traced to sanitary defects in the plumbing system.

Editor's Note: Involvement of any of these organisms in disease borne by public water supplies is in most cases still a matter of speculation.

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**Disease/Solid Waste**
**Abstracts**

**No.** DSW- 32

**Author**

**Title**
Environmental Health Needs of Metropolitan Areas

**Reference**
World Health Organization Chronicle

| **Doc. No.** | **Contract No.** | **Date issu** |
|---|---|---|
| Vol. 19, pp. 139-44 | | Apr. 1965 |

**Abstract**

Uncontrolled metropolitan growth is disquieting because of the encroachment on space (in terms of land, air and water). The potential spread of disease, and the health and sanitary problems of cities have become well known, as have the methods of dealing with them. But as populations grow, so do the problems and so does the expense of talking them: Cost is of controlling importance.. What we must search for is not merely a method of control but a feasible method of control. A U.S. estimate of 1955 was that for every 1000 new inhabitants the following are required:

(1) an additional 100,000 U.S. gallons of water a day (36.5 million gallons a year);
(2) additional sewage and treatment facilities for 170 lbs. of organic water pollutants daily (62,050 lbs. a year), or 300 new septic tank leaching systems;
(3) an expenditure of about $65,000 for the control of air pollution;
(4) 4.8 elementary-school rooms and 3.6 high-school rooms;
(5) $114,000 more, each year, for running the schools;
(6) another 8.8 acres of land for schools, parks and play areas;
(7) 1.8 more policement and 1.5 more firemen;
(8) one additional hospital bed;
(9) 1000 new library books;
(10) a fraction of a jail cell;
(11) more streets to surface, provide with storm drains, maintain, and clean; more garbage and refuse to collect.

Lack of sewerage and sewage treatment facilities in many metropolitan areas

**Descriptors**

environmental health
metropolitan areas
needs
public health aspects
sewerage
communicable diseases
industrial
research
air pollution
solid wastes
housing and open space
noise and vibration
recommendations

of the world is a major cause of communicable diseases, including cholera, typhoid, diarrhoea, dysentery, filariasis, haemorrhagic fever, and infectious hepatitis.

With regard to industrial wastes the Committee considered that metropolitan authorities should establish a policy under which industries must accept the responsibilitiy for treating their own wastes in order to meet the criteria set by responsible government agencies. Also:

> As in the case of water pollution by industrial effluents, pollution of the atmosphere by industrial and domestic emissions should look to reduction, recovery and re-use of industrial waste matters, as well as to air-cleaning in individualized and collectivized systems. In a fundamental sense, no industrial operation should be tolerated that violates the atmospheric rights and welfare of other members of the community: research into the legal and administrative aspects of air pollution is therefore much needed.

Solid wastes set an expensive disposal problem, largely because of the cost of transport, which accounts for almost 70% of the total cost. The Committee hesitated to emphasize any particular disposal system because of this factor, which is particularly important in larger communities.

Hospitals no longer constitute a special risk for the population living in the near neighbourhood:

> ...for example, enough antibiotics are carried into sewers from discharged wastes to reduce the danger inherent in the presence of many microorganisms, while radioactive isotopes are used in weak doses and according to precise rules, so that they do not harm the population in any way.

**Disease/Solid Waste**
**Abstracts**

**No.** DSW- 33

**Author** Paul Kabler

**Title** Removal of Pathogenic Microorganisms by Sewage Treatment Processes

**Reference** Sewage and Industrial Wastes

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| V. 31, No. 12,<br>pgs. 1373-1382 | | Dec. 1959 |

**Abstract**

Pathogenic bacteria, virus, and parasites in treated effluents constitute potential health hazards to persons using the receiving waters for recreational purposes. For the same reason, wet sludge and settled solids appear to be unsuitable for use in fertilizing vegetables, lawns, and shrubbery.

Although chlorination is not in general, satisfactory for parasitic ova inactivation, sedimentation for one to two hours yields removals of high percentage. Thus the solids derived from primary sedimentation and sludges from trickling filters, activated sludge, and digestion processes are apt to contain large numbers of parasites, pathogenic bacteria, and viruses.

Summary: 1. Treatment by trickling filters, activated sludge, anaerobic digestion, and stabilization ponds will markedly reduce the numbers of pathogenic enteric bacteria, virus, and tubercle bacilli in sewage, but the resulting effluents will contain a portion of each kind of microorganisms present in the raw sewage. 2. Appropriate chlorination procedures will reduce these organisms in the effluents below demonstrable densities. 3. Chemical flocculation and sedimentation appear to be the most effective procedures for removal of parasitic ova. 4. Sludges should be heat treated or dried 12 to 15 months before use as fertilizers for begetables, lawns, or shrubs. 5. More data are needed to permit full evaluation of the problem; this is especially true in relation to the efficacy of stabilization ponds and to the removal of viruses. 6. Better methods for the demonstration and enumeration of pathogenic bacteria, fungi, and viruses are urgently needed.

**Descriptors**

pathogenic bacteria
virus
parasites
effluents
health hazards
wet sludge
settled solids
fertilizing vegetables
lawns
shrubbery
trickling filters
activated sludge
anaerobic digestion
stabilization ponds
tubercle bacilli
sewage
raw sewage
chlorination
sedimentation
chemical flocculation

**Disease/Solid Waste Abstracts**

No. DSW- 34

**Author** Lester Breslow, M.D.

**Title** Environmental Carcinogenesis

**Reference**
California Medicine

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| V. 101 pgs. 371-5 | | Nov. 1964 |

**Abstract**

Not only radioactive debris but possibly other atmospheric pollutants may carry a cancer hazard. Several pieces of evidence suggest that the atmospheric pollution of large cities may be a factor in lung cancer. In general, the larger the city the more the lung cancer. Even allowing for the fact that cigarette smoking is more common in cities, there is still substantially more lung cancer in cities than in rural areas. There was a one-third exces of lung cancer among residents in cities with more than 50,000 residents than in residents of rural areas. Both in England and in the United States chemical analysis of the air has disclosed the presence of 3, 4, benzpyrene, one of the most potent carcinogens known.[16] Not only hydrocarbons but possibly also heavy metals and other substances may be present in the air of our larger cities in sufficient quanitiy to be carcinogenic.

The biological consequences of breating London air polluted with coal smoke may be quite different from those of breathing, say, Los Angeles smog which results mainly from oxidation of unburned hydrocarbons in automobile exhaust. Changes in motor vehicle exhaust and other sources of community air pollution resulting from new technologic developments could expose millions of persons to carcingenic hazards that are as yet unrecognized.

The potent carcinogen benzpyrene has been found in the soot of British cities,[20] in cigareete smoke[5] in exhaust of petroleum fuel of automobiles in Los Angeles[11] and in snow around factories in Leningrad.[5] Satisfactory means have yet to be developed for removing benzpyrene from any of the environmental situations cited in which it may be proved to be a cancer hazard.

**Descriptors**

- atmospheric pollutants
- cancer hazard
- lung cancer
- cigarette smoking
- cities
- rural areas
- 3, 4, benzpyrene
- heavy metals
- carcinogenic
- coal smoke
- smog
- cigarette smoke
- exhaust
- petroleum fuel

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Disease/Solid Waste
Abstracts

No. DSW- 35

Author

T.S. Hosty, L. Ajello, G.D. Wallace, J. Howel
& Jane Moore

Title

A Small Outbreak of Histoplasmosis

Reference

American Review of Tuberculosis and Pulmonary Disease, v.78, p.576

| Doc. No. | Contract No. | Date issu |
|---|---|---|
| American Review of Tuberculosis and Pulmonary Disease, v.78, p.576 | | Oct. 195 |

Abstract

Many investigators have verified the association of H. capsulatum with soil from avian habitats, an observation first made by Zeidberg and associates (7). Public health workers and physicians should be aware of the distinct hazard that chicken houses present directly to farmers and their families and indirectly to others. In many of the reported outbreaks, persons infected with H. capsulatum had participated in cleaning out chicken houses, towers, or other enclosed areas contaminated with bird droppings. In the report of Kier and co-workers (8), an acute episode of histoplasmosis in an individual was traced to the handling of chicken manure purchased by a city dweller for use as a fertilizer for flower beds.

Urban residents, who ordinarily have had no previous exposure to H. capsulatum - hence, have no resistance - may develop severe or fatal illness through inhalation of spores that develop in soils enriched with bird manure.

SUMMARY

An epidemiologic investigation of 3 cases of histoplasmosis, which involved a father and his two children, indicated that manure (probably from chickens), collected by the parent, was the possible source of infection. Symptoms of atypical pneumonia, i.e., marked anorexia, low fever, sore throat, cough, and depression, developed in all 3 patients, fifteen to nineteen days after they spread the manure on flower beds. Roentgenographic studies revealed pulmonary densities. A viral infection was considered to be the cause of illness. The father's infection proved fatal.

Descriptors

H. capsulatum
hazard
soil
chicken manure
avian habitats
fertilizer

Disease/Solid Waste
Abstracts

No. DSW-36

Author

G. Berg

Title

Die Virusubertragung auf dem Wasserweg

Reference

Archiv fuer Hygiene und Bakteriologie

Doc. No. Contract No. Date issued

V. 149 (314) 1965, pp. 310-35

**Abstract**

Transmission of viruses through drinking water is duscussed, and a method is presented whereby such transmission of small quantities of virus through water could be detected epidemiologically and differentiated from person-to-person transmission.

Apparently, under field conditions, commonly accepted treatment procedures do not yield virus-free elements.

What appears to be most important at the moment is that sewage effluents, after secondary treatment and even after chlorination are not free of viruses.

**Descriptors**

transmission
viruses
drinking water
sewage effluents
chlorination

**Disease/Solid Waste Abstracts**

No. DSW-37

**Author**

J. A. Aczel

**Title**

The Effect of Animal Diseases of Human Food Supplies: A Review of the World Position

**Reference**

The Veterinary Record, May 22, 1965

**Doc. No.** **Contract No.** **Date. issue**

Vol. 77, No. 21. pp. 596

**Abstract**

There is a great shortage of food in the world today especially of animal protein. This is caused by the large increase in population, as well as by inadequate production of milk, eggs and meat. Production is too low partly because of the terrific losses caused by animal diseases, which are estimated to cost about £5,250,000,000 annually (nearly 20 percent. of the value of total production).

FAO's Animal Health Yearbook (1962) has an excellent chapter on the losses caused by animal diseases (see "The economic losses ($2,419,200,000) caused by animal disease," pp. 284-313). From the FAO data, it is evident that losses range from 15 to 20 percent of animal production in most developed countries. Animal losses in the USA amount to £864,000,000 which account for 15 percent of the livestock production.

The major epizootic diseases are partly responsible for this big wastage.

It has been estimated that in the USA, losses due to internal parasites amount to £228,000,000 ($638,400,000) (which represent about 18 percent of all animal losses). Though internal parasites do not have the same dramatic effect as most of the major epizootic diseases (which are often responsible for a high mortality rate), they cause substantial losses on the quantity and quality of milk, wool and meat. In the U S. internal parasites are particularly important in pigs and poultry, as their production tends to be very intensive and concentrated so that conditions are favourable for the spread of parasites. An enormous variety of worms and protozoa are responsible for these losses in the U.S., some of the most important ones being gastro-enteritic parasites (causing losses of £40,000,000), coccidia (causing losses of £18,000,000_ and liver flukes (causing losses of £3,000,000).

**Descriptors**

shortage of food
economic losses
protozoa
animal diseases
internal parasites
epizootic diseases
human food supplies
worms

**Disease/Solid Waste**
**Abstracts**

**No.** DSW- 38

**Author**

James Watt & Dale R. Lindsay

**Title**

Diarrheal Disease Control Studies

I. Effect of Fly Control in a High Morbidity Area

**Reference**

Pub. Heal. Rep Vol. 63, Oct. 8, 1948, No. 41

| **Doc. No.** | **Contract No.** | **Date issued** |
|---|---|---|
| pp. 1319 | | |

**Abstract**

Common consent for years has ascribed to the fly a major role in the spread of enteric infections. Evidence for this belief was incomplete and did not permit an evaluation of these insects as disseminators of disease. The development in recent years of more potent insecticides particularly DDT, made it possible to plan and carry out an experiment on a broad scale designed to answer the following questions: (1) Can flies be controlled in urban populations by insecticidal methods under the limitations of action imposed by civilian life? (2) What effect, if any, will such control have on the acute diarrheal diseases of the community, particularly those caused by specific infection with the Shigella and Salmonella groups of microorganisms?

Flies reached their highest level in June of both years, 1946 and 1947. A considerable portion of these high levels was due to heavy breeding in dumps of tomato cannery wastes adjacent to the various cities. When untreated, this breeding resulted in population pressures which caused a heavy influx of flies into the adjacent (1-1/2 to 3-1/2 miles) untreated towns. The drying up of these dumps and the prevailing hot, dry weather beginning in July brought about a precipitous decline in the fly index. A secondary rise was observed in the fall of 1946, became quite definite in October of that year, and was followed by decline concurrent with cold weather in January 1947. The peak which is shown for August 1947 followed extremely heavy rains in August of that year.

In general, houseflies accounted for the greatest seasonal variation in total fly densities, and they were the most likely of all flies in this area to attain localized populations of such magnitude as to produce large-scale urban invasion.

These localized fly outbreaks emphasized an important consideration in insecticidal fly-control methods. Under some circumstances of heavy local breeding,

**Descriptors**

diarrheal disease
Shigella
tomato cannery wastes
death rates
fly control
Salmonella
houseflies
diarrhea
insecticides
dumps
deaths
dysentery

Abstract (continued)

insecticides alone are not sufficient to maintain desired fly control. Elimination of these breeding places is a much more effective operational procedure, and, in addition, can be done at considerably less expense.

From the beginning, Shigella infections were found much more commonly in the untreated areas, and the percentage of new infections found in group B was greater each month that these towns remained untreated. With the change in treatment in September 1947, the levels of new Shigella infections approached each other in the two areas; and during the last 3 months, December, January and February, a greater number of new infections was found in group A towns for the first time since the beginning of the study.

The difference in the level of Salmonella infection was not as great, and it was apparent that the degree of fly control obtained did not influence the spread of these organisms in the same way that it did with the Shigella group.

Up to the time fly control was started in January 1946, differences in the rates observed in the two groups of towns for all three causes were not greater than would be expected by chance alone. Beginning with the first-treatment quarter of 1946, and continuing through August 1947, the deaths and death rates for diarrhea and dysentery observed in the groups A towns were lower than those observed in the group B towns for the corresponding quarter. Similarly, when the change in treatment areas was made in September 1947, the observed death rates were essentially equal in that quarter, and in the succeeding quarter the death rate was higher in the group A towns.

In the area of high morbidity studied, a significant reduction in the amount of infection, disease and death resulted from the degree of control established. The effect on Shigella infections was greater than on infections with the Salmonella group of organisms.

**Disease/Solid Waste Abstracts**

No. DSW-39

Author

Norman A. Clark & Paul W. Kabler

Title

Human Enteric Viruses in Sewage

Reference

HLS - Health Laboratory Science

| Doc. No. | Contract No. | Date issu |
|---|---|---|
| Vol. 1, No. 1. pp. 44 | | Jan. 1964 |

Abstract

During the late 1930's and early 1940's it became increasingly apparent that polioviruses could be isolated readily from the feces of both paralytic and nonparalytic poliomyelitis patients. Discovery of the Coxsackie viruses by Dalldorf and Sickles (2) in the late 1940's and subsequent reports of the discovery of the ECHO viruses and adenoviruses reawakened interest in the whole problem of viruses in sewage and water. This brief review summarizes the information now available on the problem of human enteric viruses in sewage.

The fate of viruses removed by activated sludge is not clear. Kelly's data suggest that viruses may be inactivated by biological antagonists in the sludge complex - a suggestion substantiated by the isolation from sludge of at least four strains of bacteria with antiviral activity. The data of Clark et al, (20) indicate that virus removal by activated sludge is an adsorption phenomenon. They were able to recover only a very small percentage of virus from the sludge-virus complex, indicating that the complex is very stable or that the virus is in some manner inactivated.

Discussion and Summary

...there are still wide areas of ignorance in our knowledge of the effectiveness of modern sewage treatment processes in removing or destroying viruses in sewage. There is no doubt that the direct fecal-oral route is the most important chain in the transmission of these agents, yet more evidence accumulates each year that sewage-contaminated water plays a role in certain epidemics of enteric virus disease.

This review has attempted to make the following points:

1. Known human enteric vuruses number nearly 100. The true number is probably much higher.

2. It is only with the virus of infectious hepatitis that proven sewage-

Descriptors

poliomyelitis
adenoviruses
Coxsackie viruses
enteric viruses
ECHO viruses
sewage

Abstract (continued)

contaminated, water-borne outbreaks of virus disease have been recognized.

3. The number of types of viruses found in sewage are subject to rather wide fluctuations. Viruses are most prevalent in the late summer and early fall, and generally one or two types will predominate at any given time. The average density of enteric virus in sewage is probably about 500 virus units per 100 ml of sewage; the virus-coliform ratio is approximately 1:100,000.

4. The gauze pad sampling technic is superior to the grab sample when examining sewage for viruses. Concentration of the pad eluate is desirable, prefereably by ultracentrifugation.

5. Primary sewage treatment has little or no effect on enteric viruses.

6. Secondary treatment on trickling filters does not appear to be very effective, removing only about 40 percent of these viruses.

7. Secondary treatment by activated sludge is quite effective, removing 90 to 98 percent of viruses.

8. Chlorination of treated sewage effluents reduces the number of viruses, but they can still be detected in these effluents.

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(20) Clarke, N.A.; Stevenson, R.E.; Chang, S.L., and Kabler, P.W., Removal of Enteric Viruses from Sewage by Activated Sludge Treatment. A.J.P.H. 51: 1118-1129, 1961.

**Disease/Solid Waste**
**Abstracts**

No. DSW- 40

Author S.R. Weibel, F.R. Dixon,
R.B. Weidner, and L.J. McCabe

Title Waterborne-Disease Outbreaks,
1946-60

Reference
Jrl. American Water Works Association

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Vol. 56 pgs. 947-58 | | Aug. 1964 |

Abstract

During the 15-year period 1946-1960, there were 228 known outbreaks of disease or poisoning attributed to drinking water.[1] With incomplete reporting, it is difficult to determine trends in the occurrence of these episodes. There has been a consistent downward trend in the number of waterborne-disease outbreaks reported and that more recently fewer persons have been affected each year. During the 15-year review period, infectious hepatitis has been accepted as definitely a waterborne disease. Polluted water definitely contributed to the spread of infectious hepatitis, but it is apparently a minor factor in the transmission of the disease.

The number of epidemics and cases of waterborne disease (including hepatitis, is shown in Table 2. Most were classified as "gastroenteritis"; these included 126 outbreaks and 13,630 cases. This category and "diarrhea" (16 outbreaks and 5,160 cases) are not specific diseases, because the etiologic agent has not been determined through laboratory analysis. Methemoglobinemia is not mentioned among the outbreaks because it occurred only in individual cases. This disease usually occurs in infants less than 2 months old as a result of the use of well water with a high nitrate content in the formula.

The seven outbreaks listed as "other" in Table 2 included three chemical poisonings, two tularemia cases, one poliomyelitis, and one leptospirosis. Typhoid: there were 39 outbreaks with 506 cases during the period. During the review period (1946-60), sixteen deaths were attributed to waterborne disease: eight from typhoid, four from chemical poisoning, two from amebiasis, and two from shigellosis.

The 25,984 cases of illness associated with waterborne diseases occurred in a population averaging 159,000,000 (1953 population), for an annual rate of 0.0011 illnesses per 100 persons. This may be compared with the US National Health Survey figure on the occurrence of acute conditions[11]: 25.8 infective and parasitic

Descriptors

infectious hepatitis
gastroenteritis
diarrhea
methemoglobinemia
chemical poisonings
tularemia
leptospirosis
typhoid
parasitic diseases

diseases and 11.9 digestive-system conditions per 100 persons per year. In the 15-year period, there were 1.7 billion person-years of exposure to public supplies and 0.6 billion persons-years of exposure to private supplies. This gives an annual rate of 1.1 waterborne illnesses per 100,000 population served by public supplies and 0.9 waterborne illnesses per 100,000 population not served by public supplies.

In more than 50 per cent of the outbreaks associated with private of semi-public supplies, disease occurred in individuals who did not normally use the supply for their drinking water but were visitors or tourists. There are more outbreaks associated with private supplies than with public wupplies. The first review of waterborne-disease outbreaks in the United States and Canada covered the period from 1920 to 1936. The second review covered waterborne outbreaks in the United States during the 8 years, 1938-45.

Untreated ground water was most frequently the cause of outbreaks in both periods. Difficulties in the operation of treatment facilities and distribution systems were also prominent as causes.

The 15-year period covered in this study, 1946-60, involves 228 waterborne-disease outbreaks and 25,984 cases. Public utility supplies were involved in 31 per cent of the outbreaks; semipublic or private, in 69 per cent. The case distribution was reversed: 77 per cent of the cases were caused by public supplies; and 23 per cent, by semipublic and private supplies. The term "outbreak" as used in this study refers to two or more cases linked to the same causal event.

In 29 of the private-supply outbreaks associated with the useof pulluted ground water, the source of contamination was unknown. The source of the underground contamination was determined in 36 additional private-supply outbreaks, including seven associated with the old problem of creviced limestone. Twenty-three outbreaks were due to surface contamination of the ground water source.

As recently as 1951, an outbreak of an estimated 3,500 cases of gastroenteritis occurred in a community using untreated water from wells that had apparently been contaminated by flood waters.[3] In 1959, in a community receiving only sand-filtered water from a surface supply, an outbreak of typhoid fever occurred with fourteen cases and one death. Investigation revealed a carrier among three persons living in a logging camp on the watershed. It was presumed that rains washed human fecal material from a pile of animal and human manure found behind a barn at the logging camp downgrade to a brook running into the stream supplying a reservoir above the filter.[15]

## References

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Disease/Solid Waste
Abstracts

No. DSW- 41

Author

Willard H. Wright

Title

Studies on Trichinosis XI. The Epidemiology of Trichinella spiralis Infestation and Measures Indicated for the Control of Trichinosis

Reference

Amer. J. of Pub Health, Feb. 1939, pp119

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| | | |

Abstract

The basic series comprising over 2,100 diaphragms at this writing shows a trichina incidence of 16.8 percent, and the random and negative series show incidence of 18.3 and 18.6 percent, respectively, figures which are within 2 standard deviations of findings in the base series. The traumatic series, with yet a relatively small number of diaphragms, has an incidence of 13.8 percent, a somewhat lower incidence than the other series. However, since positive findings fluctuate considerably from time to time in small samplings, there is reason to believe that this series will eventually show a percentage of positives close to the figure of the base series. If the Jewish series with a remarkably low incidence of 0.7 percent is omitted, it is noted that 17.0 percent of the remaining diaphragms were positive for trichinae.

Our findings are in quite general accord with the summarized findings of trichina surveys conducted in various parts of the United States by other investigators.

The heaviest incidence areas lie along the North Atlantic seaboard and along the Pacific coast, areas in which the feeding of uncooked garbage to swine is extensively carried on.

Swine fed on cooked garbage and southern swine raised generally in fields and woods and without easy access to garbage or kitchen scraps rank in the lowest order of importance as sources of human trichinosis. Only about 0.5 percent of these swine have been found to harbor trichinae.

Swine fed on uncooked garbage rank next in the order of importance as a source of human trichinosis and probably today represent the chief source of the disease in man.

There is no doubt that many American municipalities are contributing directly to the spread of trichinosis through sanction of the practice of feeding uncooked

Descriptors

epidemiology
trichinella spiralis
cooked garbage
control
uncooked garbage
trichinosis
swine

Abstract (continued)

municipal garbage to swine maintained either on farms operated by the municipality or on farms operated by private contractors.

As much of the pork fed on municipal garbage is slaughtered locally, swine maintained on uncooked city garbage are an important source of trichinosis within the municipality.

**Disease/Solid Waste Abstracts**

No. DSW-42

Author

L. W. Slanetz and Clara H. Bartley

Title

Survival of Fecal Streptococci in Sea Water

Reference

Health Lab. Science, V. 2, Jul 1965, pp.142

| Doc. No. | Contract No. | Date issue |
|---|---|---|

Abstract

SUMMARY

If appreciable organic or nutrient material is present in sewage contaminated sea water, the numbers of fecal streptococci in such water may give a more accurate estimate of the degree of pollution than coliforms or fecal coliforms since they do not multiply in such water and they show appreciable die-off rates within a 2-3 da period.

Descriptors

bacteria (survival)
water (sea)

**Disease/Solid Waste**
**Abstracts**

No. DSW-43

Author

R. J. Huebner, et al

Title Rickettsiapox-A Newly Recognized Rickettsial Disease (IV)

Reference

Pub. Health Rep. Vol. 61, , No. 47

Doc. No. Contract No. Date issued

pp. 1677 22 Nov. 1946

Abstract

The purpose of this paper is to report the isolation of a rickettsia from each of two pools of mites (*Allodermanyssus sanguineus* Hirst, a rodent ectoparasite) collected in a housing development in New York, N.Y., where more than 80 cases of rickettsialpox have occurred.

Several hundred specimens of A. *sanguineus* in various stages of development and engorgement were collected. Some of the mites were found on freshly trapped house mice-in one instances 10 mites were found feeding on the rump of a young mouse. The majority of the mites, however, were found crawling on the external walls of basement incinerators. It was not unusual to collect as many as 100 mites from the walls of a single incinerator. Many of the mites were fully engorged and bright red in color at the time of collection. Typical mammalian erythrocytes were found in smears of these freshly engorged mites. No other rodents or rodent parasites were found by us at this location.

SUMMARY

The recovery of apparently identical strains of rickettsia from a man ill with rickettsialpox and from bloodsucking mites collected from the domicile of the same man indicates that human infection is acquired from the mites, probably through biting.

The isolation of this agent from mites has established further its characteristics as a micro-organism of the rickettsial group.

Descriptors

Rickettsialpox
*Allodermanyssus sanguineus*
Hirst,

mite
rodent
vector

rickettsia
reservoir
mouse

Disease/Solid Waste
Abstracts

No. DSW- 44

Author

J. Borneff and R. Knerr

Title Cancerogene Substanzen in Wasser und Boden, III. Quantitative Ermittlungen zur Loslichkeit, Filtration, Adsorption und Eindringtiefe

Reference

Arch. fuer Hygiene und Bakteriologie V. 144, 1960, pp. 81

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| | | |

Abstract

SUMMARY

In the course of investigations performed with the aim to protect the quality of drinking water soil contaminated artificially by cancerogenic compounds has been evaluated by quantitative laboratory and field experiments. The solubility of dibenzanthracene in drink water was lower than 1:1(11); this means that compounds of that kind do occur virtually only as suspension or emulsion when the contaminate drink water. The influence exhibited by surface active agents is still not clear. Particles containing cancerogenic compounds (asphalt, tar, soot, and so on) of the seize downwards to about 10 mμmay traverse vertically the soil layers and may reach the subsoil water only in those cases where, apart from this, the water is rejected for consumption by human beings from the hygenic and bacteriological standpoint, because of the source of the water, the way it has been obtained or the results obtained by the water analysis. The behaviour of cancerogenic compounds in soil under the influence of solvents, e.g., gasoline, benzene, heating oil, detergents, can be judged definitively not untill further experiments have been performed. According to the results obtained benzopyrene dissolved in benzene seems to be retained to a greater extent than the solvent by relatively strong adsorbing layers of soil.

Descriptors

**Disease/Solid Waste Abstracts**

No. DSW- 45

**Author**

J. Borneff

**Title**

Cancerogene Substanzen in Wasser und Boden

IV

**Reference**

Archiv fuer Hygiene und Bakteriologie

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| v. 144, p. 249 | | 1960 |

**Abstract**

The action exhibited by detergents on the development of carcinoma of the forestomach of mice has been examined. 3,4-benzopyrene (25 ug daily per mouse during 400 days) did produce carcinoma only when benzopyrene solubilized by surface active compounds was given in drinking water. The solubilization of cancerogenic compounds by detergents contained in waste water or in surface waters contaminated by waste water is quite conceivable; the experimental proof is still lacking.

**Descriptors**

3,4-benzopyrene
cancinoma of the forestomach
mice
drinking water
solubilization
detergents
waste water
surface waters
contaminated
waste water

**Disease/Solid Waste**
**Abstracts**

No. DSW- 46

Author

Borneff, J. Fischer, R.

Title

Cancerogene Substanzen in Wasser und Boden

VIII

Reference

Archiv Fuer Hygiene und Bakteriologie

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| v. 146 p. 1 | | 1962 |

**Abstract**

Summary

The extraction of filter carbon that had been used for two years in a river water supply plant led to the demonstration of the non-cancerogenic hydrocarbons fluoranthene, 10, 11-benzfluoranthene, 11, 12-benzfluoranthene and the cancerogenic compounds 3,4-benzpyrene, 3,4-benzfluoranthene, and 1,12-benzperylene, as well as additional fluorescing substances that could not be identified because the quantities present were too small. The dosage of cancerogenic substances taken up per person per year is estimated to be of the order of milligrams when surface water is used for human consumption without preliminary carbon filtration. It must be considered as very probably that an exposure to cancerogenic hazards is thus created.

**Descriptors**

filter carbon

river water supply
non-cancerogenic hydrocarbons
fluoranthene
10, 11-benzfluoranthene
11, 12-benzfluoranthene
cancerogenic compounds
3.4-benzpyrene
3,4-benzfluoranthene
1,12-benzperylene
surface water

human consumption
cancerogenic hazards

**Disease/Solid Waste**
**Abstracts**

No. DSW-47

Author

Leo Walter

Title

Composition of Sewage and Sewage Effluents -

Part 1

Reference

Water & Sewage Works, Nov. 1961, v. 108

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| p. 428 | | |

Abstract

## Conclusions

Up to three-quarters of the organic carbon content of crude domestic sewage has been assigned to chemical groups, leaving 70 to 100 ppm unidentified; most of this was in suspension. Sufficient information is now available concerning the composition of sewage for use in theoretical studies of the kinetics of sewage purification, such as those recently discussed by Downing and Wheatland (12).

It is thought unlikely that any major soluble constituent has been overlooked, and it is suggested that the 20 ppm or so organic carbon remaining unidentified is probably made up of small concentrations of a large number of compounds. Other substances have, in fact, been detected in Stevenage sewage; for example, phenols, sterols and uric acid each accounted for about 1 ppm carbon, and aliphatic amines for about 0.1 ppm. The literature contains references to the presence in very low concentrations of many more compounds, including vitamines, hormones condensed aromatic hydrocarbons, indole and skatole. In suspension, however, 50 to 80 ppm carbon remained unidentified and major groups may still remain undetected.

...the three main classes of organic matter in domestic sewage were readily removable by biological filtration, proteins being somewhat less readily removed than fats and carbohydrates.

It is proposed to extend the program of analytical work to include raw and digested sewage sludges. These present a rather different problem, since the organic carbon content is about a hundred times greater than that of settled sewage; about 90 percent of this is in suspension compared with 50 percent in settled sewage.

...the rate of breakdown of a compound, whether by aerobic or anaerobic treatment, depends on its state of organization. It may be present as the free compound, as a polymer, or as part of a plant or bacterial cell.

Descriptors

sewage
biological filtration
organic carbon
aerobic
sludges
anaerobic

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(12) Bunch, R.L., Barth, E.F., & Ettinger, M.B. "Organic Content of Secondary Sewage Effluents", Paper No. 8., Conf. on Biological Waste Treatment, Manhattan Collete, N.Y. (April 1960).

Abstract (continued)

Table 4

Composition of Stevenage sewage and of the effluent obtained on treatment in a percolating filter.

| Constituent | Sewage (24-hr composite sample) Whole | Settled (BOD = 380 ppm) Soluble | Settled (BOD = 380 ppm) Total | Effluent Whole (ppm) | Effluent Settled (BOD = 12 ppm) Soluble | Effluent Settled (BOD = 12 ppm) Total | Removal by biological filtration | Removal by biological filtration followed by settlement (per cent) |
|---|---|---|---|---|---|---|---|---|
| Fatty acid | 71.0 | 0 | 46.1 | 0.12 | 0 | 0.04 | 99 | 99 |
| Fatty ester | 28.2 | 0 | 23.5 | 0.12 | 0 | 0.02 | 99 | 99 |
| Protein | 31.0 | 8.0 | 21.5 | 2.99 | 0.99 | 0.99 | 86 | 95 |
| Amino acids | 5.0 | 5.0 | 5.0 | 0.06 | 0.06 | 0.06 | 99 | 99 |
| Carbohydrates | 55.0 | 40.0 | 46.0 | 1.63 | 0.24 | 0.57 | 96 | 99 |
| Soluble acids | 21.0 | 17.0 | 19.8 | 1.78 | 1.65 | 1.69 | 91 | 91 |
| Amides | 1.5 | 0 | 1.0 | (not determined) | | | — | — |
| Anionic surface active agents | 14.0 | 11.0 | 13.1 | 1.45 | 1.40 | 1.41 | 89 | 89 |
| [illegible] | 3.5 | 3.5 | 3.5 | (not determined) | | | — | — |
| Amino sugars | 1.8 | 0 | 1.1 | 0.38 | 0 | 0.07 | 65 | 94 |
| Muramic acid | 0.7 | 0 | 0.1 | 0.05 | 0 | 0.01 | 50 | 90 |
| Organic carbon by analysis | [illegible] | 106 | 228 | 26.9 | 14.0 | 16.5 | 88 | 93 |
| by addition | 232 | 95 | 181 | 8.6 | 3.6 | 4.9 | — | — |
| Percentage identified (per cent) | [illegible] | 90 | 79 | 32 | 26 | 29 | — | — |

Table 5

Distribution of organic carbon and nitrogen between suspension and solution in effluent from percolating filter treating Stevenage domestic sewage.

| Constituent | Coarse suspension | Fine suspension | Solution | Whole |
|---|---|---|---|---|
| | (parts per million) | | | |
| Organic C | 10.4 (39) | 2.5 (9) | 14.0 (52) | 26.9 (100) |
| Total N (Kjeldahl) | 1.7 (37) | 0.4 (9) | 2.5 (54) | 4.6 (100) |
| Oxidized N | 0 | 0 | 68.0 | 68.0 |
| Ammonia N | 0 | 0 | 1.5 | 1.5 |
| Suspended matter | 31.2 | 8.8 | 0 | 40.0 |

Figures in brackets are percentages of total concentration.

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Disease/Solid Waste
Abstracts

No. DSW-48

Author

H. A. Painter and M. Viney

Title

Composition of a Domestic Sewage

Reference
Journal of Biochemical and Microbiological Technology and Engineering v. 1, no. 2

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| p. 143 | | 1959 |

Abstract

Summary. An analysis of the organic constituents of whole, domestic sewage was made . . . The average concentration of organic carbon in fresh, whole domestic sewage was 310 p.p.m., of which about 70 per cent was in suspension. Eight classes of compounds were found, on analysis, to comprise about 75 per cent of the organic carbon in whole sewage and of the soluble organic carbon 80 per cent was distributed between five groups. . . . the concentrations of four volatile acids were determined and the presence of other acids was detected. Similarly, seven of the soluble sugars and eight present in hydrolysed suspended solids have been identified.

Consideration of the origin of sewage suggests classes of compounds likely to be found, e.g. carbohydrates, fats, proteins, urea, . . .

A general analysis of the three grades of suspended solids showed that the content of organic nitrogen increased and the carbon:nitrogen ratio decreased with decreasing particle size.

It is to be emphasized that the analyses refer to fresh sewage from a group of about 6,000 people. The composition may be expected to be different in sewage which is not so fresh and even domestic sewage from other sources may have a somewhat different composition, depending on local habits.

Descriptors

domestic sewage
carbon:nitrogen ratio
organic carbon
suspended solids

**Disease/Solid Waste Abstracts**

No. DSW- 49

Author

John Wiley

Title

Solid Waste Problems in Metropolitan Areas

Reference reprint from:
Texas Town and City 50(3) 12-13 et. seq., March 1963 (Compost Science, Summer 1963)

| Doc. No. | Contract No. | Date issu |
|---|---|---|
| | | |

Abstract

The storage, collection and disposal of the solid refuse of a community will be satisfactory only if these basic requirements are met:

(1) danger to public health is absent;

(2) there is minimum nuisance to the public; and

(3) the sanitary disposal of all refuse materials is effected at minimum expense.

Per capita refuse production varies from two to five pounds per day, . . . The total amount of refuse is continually increasing. Refuse collection and disposal costs in the United States are presently estimated at $1.8 billion per year. Of every $10 spent on refuse handling, about $8 are for collection and $2 for disposal.

In the best systems, the three steps -- storage, collection and disposal -- are coordinated in both planning and operation to best meet the local needs. Economy may indicate the need for another step -- transfer -- in some of our larger cities.

Two major storage problems are insects and rodents. Garbage is probably the greatest single source of food for rats in a given community.

Even good containers do not prevent access of flies. Two other important factors help to reduce the fly problems at premises; frequent collection and wrapping of garbage.

Descriptors

storage problems
insects
rodents
garbage
flies
air pollution
sewage sludge
governmental jurisdictions
collection
transfer stations
disposal
sanitary landfill
incineration
organic wastes
salvage
composting
land use
zoning
pollution
ground waters
surface waters
value of compost

**Abstract (continued)**

Minimum collection frequency for putrescible materials should be weekly; non-combustible rubbish or ashes may be collected less frequently.

Commercial, trade and manufacturing refuse, demolition debris, agricultural solid wastes, and other special classes of solid wastes are often not the responsibility of the regular collection agency but should be considered in planning.

The use of refuse transfer stations is a matter of economics which may affect the type of disposal method adopted.

Extensive engineering study and planning are required before the best system of storage, collection and disposal can be established for a given community.

Three acceptable methods of disposal exists for handling combined refuse-sanitary landfill, incineration and composting. The latter two require landfilling of 10 to 25% of the wastes, depending on how much salvage is practiced.

The garbage portion of the total refuse, amounting to less than 10% by volume, . . .

Sanitary landfill is the least expensive satisfactory method of refuse disposal. For an eight-foot depth of compacted refuse, it requires one acre/year/ 10,000 population.

The many factors involved in present and future land use, development, zoning, and community facilities should be considered in connection with site selection. Another important consideration is possible pollution of ground or surface waters.

Incineration is a sanitary method of disposal of the bulk of solid wastes produced by a community. Both capital and operating costs are relatively high . . .

Skilled operation is necessary, especially to control dust emission and to prevent air pollution from the flyash and stack gases.

Composting is the aerobic decomposition of organic wastes to a relatively stable humus-like material. The microbial decomposition is an oxidation process producing heat and liberating primarily only carbon dioxide and water. The heat produced is sufficient to destroy plant and animal pathogens, fly eggs and larvae, and seeds. Thus, the compost has greater value than digested sludge for use on land. The composting process can treat a wide variety of organic wastes, including combined refuse and sewage sludge, . . .

Abstract (continued)

In composting plants receiving combined refuse, the sorting and processing removes about 25% of the total weight for salvage or discard. Disposal of 10 to 25% of the raw materials must be by other methods than by salvage. Reduction in dry weight of 35% to 50% occurs, as well as at least 50% reduction in volume.

. . . agricultural scientists have not yet determined the value of compost in various agronomic uses.

In the total long-range planning for metropolitan solid waste disposal there will be much overlapping of governmental jurisdictions.

Disease/Solid Waste
Abstracts

No. DSW-50

Author
P. V. R. Subrahmanyam, C. Anandeswara Sastry, A. V. S. Prabhakara Rao, and S. C. Pillai

Title

Amino Acids in Sewage Sludges

Reference
Journal WPCF, April 1960, Vol. 32, No. 4
pp 344 - 350

Doc. No. Contract No. Date issue

Abstract

Activated sludge contained a much higher amount of amino acids than chemically precipitated sludges, septic tank sludge, raw sewage solids, or cow dung. This feature of activated sludge may, at any rate, partly be due to its action of rapidly removing practically all the amino acids from the sewage.

Among the known methods of sewage treatment, activated sludge appeared to be the only system capable of removing the amino acids practically entirely from sewage.

Baly (7) stated . . . "the process not only purifies the sewage from all harmful impurities, but also removes the bacteria, so that a sterile or almost sterile effluent is obtained."

Summary

The amino acid composition of raw sewage solids, chemically precipitated sludges, septic tank sludge, activated sludge, protozoa in the activated sludge and cow dung was studied. All these materials contained practically all the essential amino acids, the activated sludge and the protozoa containing by far the highest amounts. Cystine was not present in the samples of septic tank sludge and cow dung examined.

During purification of sewage by the activated sludge process as well as during natural purification of flowing sewage, the amino acids in the sewages were removed at a rapid rate, so that the final effluents from these systems were

Descriptors

amino acids
sewage
sludges
activated sludge
chemically precipitated sludges
tank sludge
raw sewage solids
cow dung
bacteria
protozoa
bacteria

Abstract (continued)

practically free from the amino acids. The significance of these and other observations is discussed.

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(7) Baly, E. C. C., "The Mechanism of the Activated Sludge Process of Sewage Disposal." Jour. Soc. Chem. Ind., 50, 22% (1931).

Abstract (continued)

**TABLE I.—Nitrogen Content of Different Sewage Sludges and Other Materials**

| Material | Nitrogen (Percentage on oven-dry basis) |
|---|---|
| Raw sewage solids | 2.96 |
| Sludge precipitated with alum | 2.83 |
| Sludge precipitated with lime | 1.15 |
| Sludge from the septic tank | 3.80 |
| Activated sludge | 7.73 |
| Protozoa in activated sludge (*Epistylis sp.*)* | 10.51 |
| Cow dung | 0.99 |

* Obtained from the activated sludge plant at Ambasamudram (Madras State).

**TABLE II.—Amino Acids in Sewage, Sludges, and Related Materials, mg/g of the Dried Solids**

| Amino Acid | Raw Sewage | Alum Sludge | Lime Sludge | Septic Tank Sludge | Activated Sludge | Protozoa (*Epistylis sp.*)* | Cow Dung |
|---|---|---|---|---|---|---|---|
| Cystine | 3.9 | 1.6 | 1.0 | 0 | 4.2 | 8.0 | 0 |
| Lysine and histidine | 5.5 | 5.5 | 7.5 | 4.2 | 22.4 | 31.6 | 1.7 |
| Arginine | 6.7 | 4.4 | 2.5 | 5.2 | 14.0 | 20.2 | 0.8 |
| Serine, glycine, and aspartic acid | 18.3 | 7.3 | 6.3 | 9.7 | 31.4 | 34.6 | 1.7 |
| Threonine and glutamic acid | 9.5 | 10.0 | 7.0 | 8.8 | 40.1 | 46.1 | 1.7 |
| Alanine | 7.0 | 5.8 | 3.9 | 7.4 | 23.4 | 27.8 | 1.3 |
| Proline | 0 | 0 | 0 | 0 | trace | trace | 0 |
| Tyrosine | 3.5 | 4.4 | 4.6 | 3.4 | 10.8 | 13.1 | 0 |
| Methionine and valine | 15.1 | 8.7 | 3.2 | 7.8 | 27.8 | 37.8 | 2.3 |
| Phenylalanine | 11.1 | 5.5 | 5.9 | 4.1 | 26.5 | 30.1 | 2.3 |
| Leucines | 10.7 | 8.9 | 5.2 | 9.2 | 29.9 | 40.0 | 2.6 |
| Total | 91.3 | 62.1 | 47.1 | 59.8 | 231.1 | 289.3 | 14.4 |

* Obtained from the activated sludge plant at Ambasamudram (Madras State).

Abstract (continued)

TABLE V.--Rate of Removal of Amino Acids from Sewage by Activated Sludge, mg/g of the Dried Solids

| Amino Acid | Raw Sewage | Effluents Obtained After Aeration of Sewage with 15-Per Cent Activated Sludge for Various Times* | | | |
|---|---|---|---|---|---|
| | | ½ hr | 1 hr | 2 hr | 4 hr |
| Cystine | 9.4 | 1.7 | 0.8 | 0 | 0 |
| Lysine and histidine | 7.2 | 1.7 | 4.6 | 2.3 | 0 |
| Arginine | 11.0 | 8.6 | 7.6 | 3.5 | 0 |
| Serine, glycine, and aspartic acid | 18.3 | 14.2 | 13.9 | 9.5 | trace |
| Threonine and glutamic acid | 4.5 | 3.1 | 2.0 | 1.4 | trace |
| Alanine | 6.1 | 4.2 | 4.0 | 3.0 | 0 |
| Proline | 0 | 0 | 0 | 0 | 0 |
| Tyrosine | 3.5 | 1.8 | 1.8 | trace | 0 |
| Methionine and valine | 10.0 | 7.4 | 5.2 | 2.9 | 0 |
| Phenylalanine | 4.7 | 3.3 | 1.6 | 0.4 | 0 |
| Leucines | 11.3 | 6.9 | 6.8 | 2.8 | 0 |
| Total | 86.0 | 55.9 | 48.3 | 25.8 | — |

* Effluents obtained after aeration for 6 and 24 hr did not contain any amino acid.

TABLE VII.--Removal of Amino Acids from the Sewage Flowing on Land Having 1-in-50 Gradient, mg/g of the Dried Solids

| Amino Acid | At the Outfall | Distance in Miles from the Outfall | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0.17 | 0.38 | 0.57 | 0.71 | 0.92 | 1.20 |
| Cystine | 6.9 | 3.2 | 3.1 | 2.5 | 1.4 | trace | 0 |
| Lysine and histidine | 9.4 | 4.2 | 4.0 | 2.4 | 0.9 | trace | 0 |
| Arginine | 6.1 | 4.5 | 3.0 | 2.1 | 0.8 | trace | 0 |
| Serine, glycine, and aspartic acid | 17.8 | 10.2 | 9.7 | 7.7 | 3.4 | 1.2 | trace |
| Threonine and glutamic acid | 20.6 | 16.7 | 14.9 | 10.2 | 4.1 | 1.8 | trace |
| Alanine | 9.4 | 3.5 | 2.3 | 2.0 | 1.2 | 0.5 | trace |
| Proline | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tyrosine | 5.3 | trace | trace | trace | trace | 0 | 0 |
| Methionine and valine | 11.7 | 6.9 | 4.9 | 2.8 | 1.2 | 0.8 | 0 |
| Phenylalanine | 8.3 | 5.4 | 5.0 | 2.9 | trace | trace | trace |
| Leucines | 13.9 | 6.3 | 4.6 | 2.9 | 1.3 | trace | 0 |
| Total | 115.3 | 60.0 | 51.5 | 35.5 | 14.3 | 4.3 | — |

Disease/Solid Waste
Abstracts

No. DSW-51

Author

W. C. Hueper and W. W. Payne

Title

Observations on the Occurrence of Hepatomas in Rainbow Trout (1)

Reference

Journal National Cancer Institute 1961

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| v. 27, no. 5 p. 1124 | | Nov. 1961 |

Abstract

## SUMMARY

Rainbow trout reared in hatcheries throughout the United States suffer from an epidemic of primary liver cancer, which in some instances seems to affect practically 100 percent of the trout population over 3 years of age. . . . the recent introduction of processed commercial feed have attracted the main attention. The bulk of available evidence at present incriminates some constituent, or constituents, in the feed as a nutritive factor, a chemical additive, or a medicinal agent. . . . this epidemic . . . , provides a serious warning of the possible future production of a similar cancer epidemic in the human population through an increasing contamination of the human environment with some of the many industry-related carcinogenic chemicals.

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(1) Hueper, W. C.: Carcinogens in the human environment. Arch. Path. 71: 237-267, 355-380, 1961.

Descriptors

rainbow trout
hatcheries
epidemic
primary liver cancer
contamination
human environment
industry-related
carcinogenic chemicals

**Disease/Solid Waste**
**Abstracts**

No. DSW-52

Author

Arthur A. Siniscal, M. D.

Title

The Trachoma Story

Reference

Public Health Reports, Vol. 70, No. 5, May 1955

| Doc. No. | Contract No. | Date issued |
|---|---|---|

**Abstract**

Trachoma is not highly contagious; . . . Because trachoma is more likely to be transferred from one member of a family to another member than to contacts outside the home, it is sometimes referred to as a family disease, but it is not hereditary.

. . . trachoma is more likely to spread where unsanitary and overcrowded living conditions prevail.

In general, a high incidence of trachoma is observed in areas with a high mean temperature and little rainfall and in flood districts near the estuaries of large rivers. In all of these, sun, wind, and dust act as conjunctival irritants and are factors predisposing to the infection.

. . . it is the opinion of this writer, as well as that of other observers, . . ., that inadequate diet and avitaminosis are contributory factors. At present, however, this concept must be regarded as unproved.

In Missouri, the disease predominates among persons of northern European ancestry, . . . The disease became established in these families and still flourishes in some of their settlement areas, notably in the southern half of the State. Negroes in the State do not acquire the disease.

Trachoma is a disease of recurrences and relapses. The infection may have become dormant or latent so that not infrequently an arrested case may later

**Descriptors**

trachoma
unsanitary
living conditions
estuaries
sun
wind
dust
diet
avitaminosis
dormant
latent

Abstract (continued)

show signs of activity. A recurrence may be due to the patient's having returned to an environment of smoke, dust, or wind, or to a mode of living not conducive to eye health.

**Disease/Solid Waste Abstracts**

No. DSW-53

Author

Dauer

Title

Food and Water Borne Disease Outbreaks -

Incidence of Infectious Hepatitis by State

Reference

Publ. Health Report, Vol. 67, No. 11, 11/52

Doc. No. Contract No. Date issue

Abstract

Faulty methods of handling food and poor hygiene on the part of food handlers were frequent findings in investigations of outbreaks of food-borne disease in which foods other than milk were the vehicles of infection, according to 1951 reports of such outbreaks.

In four reported outbreaks of disease, milk apparently was the vehicle of infection.

Ice cream was the vehicle of infection in 3 outbreaks of food poisoning....

Raw buttermilk, from which a staphylocossus was isolated, was believed to be the source of infection in a small outbreak.... Fruit cottage cheese, from which Escherichia coli was isolated, was regarded as the vehicle of infection in another small outbreak, and in two others processed cheese caused symptoms of food poisoning.

Contaminated foods other than milk, milk products, and shellfish were the cause of nine-tenths of the common-source outbreaks of food poisoning reported in 1951. In 53 outbreaks poultry meat and eggs were found or suspected to be the vehicle of infection. Of these, 8 proved to be caused by Salmonella, which suggests that the fowl or eggs were naturally infected. Processed hams, frequently precooked, were the source of infection in 38 outbreaks, nearly all of them due to a staphylococcus. Beef, usually roasted, was found to be the probable source of infection in 32 outbreaks, and miscellaneous meats in 25. Custard-filled pastries were another common vehicle of infection. Salads, fish, sandwich fillings or spreads, and creamed vegetables were suspected of being the source of infection in 34 outbreaks.

Shellfish were regarded as the source of infection in only one outbreak.

In 63 outbreaks of food poisoning reported in 1951 the presence of a

Descriptors

shigellosis
milk & milk products
typhoid fever
food handlers
shellfish
trichinosis
food-borne disease
staphylococcus

Abstract (continued)

staphylococcus in the food was demonstrated by laboratory tests.

Only three outbreaks of typhoid fever were reported in 1951.

...there were slightly more than 2,100 cases of typhoid fever reported in the country as a whole in 1951. Many of these may have been infected by water, milk, or other foods, the real source of infection probably being a carrier having direct or indirect contact with these vehicles of infection.

Fifteen outbreaks of Salmonella infections, with 850 clinical cases, were reported in 1951. Eight different types of the organism were found.

Poultry meat or eggs were found to be the vehicle of infection in 8 of the 15 outbreaks.... Home-made ice cream in which duck eggs were used caused illness in 30 persons.

Ten cases of milk-borne S. paratyphi B infection were traced to the nephew of a dairyman.

Salmonella infection associated with poultry meat occurred in California.

Spaghetti, chopped liver, baked ham, cream filling in chocolate eclairs, and baked Alaska also appear to have been the vehicles of infection in outbreaks of salmonellosis.

Seven outbreaks of trichinosis were reported during the year, involving 32 cases with no deaths. Poorly cooked "local" pork, homemade sausage, and ham were reported as the types of pork eaten.

Ninety-two outbreaks of illness were reported in which no determination of type of infection could be made from the details recorded.

There was only one report of an outbreak of Shigella infection with definite evidence of transmission by food or water, and seven outbreaks were considered to be person-to-person types of infection. Shigellasonnei was isolated in six instances, and a flexneri type of organism in one. Four outbreaks occurred in institutions, one each in a summer camp and a school, and two were family outbreaks. In the eight outbreaks, 381 persons were reported to have been ill.

Five outbreaks of diarrhea of the newborn were reported, four in New York State, and one in Illinois. Fifty-four cases with two deaths were reported. The means by which the infection was introduced were not determined in any of the five outbreaks, although in two instances contact with an infected person was considered to be the most likely mode of spread. In one small outbreak of three cases, an organism of the Salmonella group was isolated from the stools of one infant.... The outbreak in Illinois was explosive in character, and occurred simultaneously with reports of transient diarrhea in the general population served by a hospital.

**Disease/Solid Waste**
**Abstracts**

No. DSW-54

Author

George F. Mallison & William F. Hohloch

Title

The Composition of Residential Garbage

Reference

Public Works for June 1956, pp. 112

| Doc. No. | Contract No. | Date issue |
|---|---|---|

Abstract

The total weight of garbage sorted per month varied from 16.3 to 41.6 pounds.

...most citrus fruit waste was disposed of during the winter and early spring. Also, the highest percengage of green and salad vegetable and melon waste and the lowest percentage of starchy food waste was thrown away during the summer months.

The yearly average data on the composition of East Lansing garbage(Table 2) is comparable to that collected in a similar study in 1940 on New York City refuse (3), except that considerably more meat, fat, and fish and much less citrus was found in East Lansing garbage than in New York City food refuse.

A suitable synthetic garbage for laboratory purposes may be produced by combining a few of the most representative materials in each constituent group in Table 2 in the proportions shown. This material would have a calculated moisture content of 60 percent, a value that is in agreement with the average moisture content actually found in large quantities of East Lansing residential garbage during composting investigations.

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(3) Survey of Landfill Characteristics, New York City. Anon. 90 pp. Published by New York City Dept. of Sanitation as a report on Official Project, No. 65-1-97-[illegible] W.P.SU-1, Fed. Works Agency, Work Porjects Admin. for the City of New York. Feb, 1941

Descriptors

citrus fruit waste

composition

residential garbage

Abstract (continued)

**Table 2—Average Percent Moisture Content and Composition of Residential Garbage, East Lansing, Michigan, 1954**

| *Constituent* | *Moisture Content* | *Wet-Basis Composition* | *Dry-Basis Composition* |
|---|---|---|---|
| Paper | 31.0 | 19.8 | 33.2 |
| Meat, fat, fish and dairy products | 24.4 | 8.3 | 15.2 |
| Citrus fruit | 83.8 | 11.3 | 4.4 |
| Fruit not citrus | 85.6 | 6.8 | 2.4 |
| Green and salad vegetables and melons | 92.8 | 20.2 | 3.5 |
| Coffee grounds and tea leaves | 63.8 | 3.9 | 3.4 |
| Bread, pastry, sugar and cereals | 33.6 | 8.5 | 13.7 |
| Corn, beans, potatoes, etc. | 81.2 | 11.4 | 5.2 |
| Miscellaneous | 20.0 (Est.) | 9.8 | 19.0 |

**Table 3—Estimated Average Percent Composition of Unwrapped Residential Garbage**

*(Calculated on Wet Basis)*

| | |
|---|---|
| Meat, fat, fish and dairy products | 10 |
| Citrus fruit | 15 |
| Fruit not citrus | 10 |
| Green and salad vegetables and melons | 25 |
| Coffee grounds and tea leaves | 5 |
| Bread, pastry, sugar and cereals | 10 |
| Corn, beans, potatoes, etc. | 15 |
| Miscellaneous | 10 |

Disease/Solid Waste
Abstracts

No. DSW-55

Author
H. W. Van Gils

Title
Bacteriology of Activated Sludge

J. Microbiology and Aerology, V. 31, 1965
Reference 21-11-64
Netherlands Soc. of Microbio. Meeting

Doc. No. Contract No. Date
p. 222

Abstract

The bacterial population of the flocs in different types of activated sludge was investigated; about 100 strains per sludge sample were isolated from high dilution count plates and their morphological and physiological characteristics were determined.

The predominant flora of activated sludge grown in domestic waste water in the Zeist purification plant or in a laboratory apparatus consisted of aerobic gram-negative non-spore-forming rods of the family Achromobacteraceae (genera Alcaligenes, Flavobacterium and Achromobacter). In activated sludge grown in synthetic waste water (mineral salts, glucose, and ammonium sulphate) about one-half of the isolated bacterial strains belonged to the Achromobacteraceae while the other half consisted of Micrococcaceae and of large ovoid encapsulated bacteria as yet unclassified.

The same types of activated sludge were used for metabolic investigations together with washed suspensions of pure bacterial cultures isolated from domestic sludge. The poor utilization of sugars by sludge and washed cultures of bacteria grown in sewage or in media devoid of sugars might be explained by the assumption that adaptation to sugar break-down had not occurred. When nitrogen compounds, particularly amino acids, were supplied along with glucose to non-adapted sludge or bacterial suspensions, a ready adaptation to glucose break-down occurred. Adaptation of existing cells as well as selection of bacterial strains capable of consuming glucose were found to be responsible for substrate adaptation when the sludge had been grown on sugar-containing media. Dissimilation of 10-20% of the consumed glucose and of 30-40% of the consumed acetate was found in activated sludge supplied with these substrates. Washed suspensions of bacterial strains behaved similarly, though dissimilation percentages for glucose were higher.

Descriptors
activated sludge
domestic waste water
flocs
bacteria
synthetic waste water

Abstract (continued)

It is concluded that glucose consumption by the bacterial cells of the sludge flocs rather than diffusion of the glucose melecules into the sludge is the limiting factor in substrate removal. Further, the enzymatic decomposition of glucose in the bacterial cells rather than glucose uptake is rate-limiting in the removal of glucose by activates sludge.

**Disease/Solid Waste
Abstracts**

No. DSW-56-I

Author

F. F. Dias & J. V. Bhat

Title

Microbial Ecology of Activated Sludge

I. Dominant Bacteria

Reference

Applied Microbiology, Vol. 12, No. 5, p.

Doc. No. Contract No. Date issue

412-417, Sept. 1964.

Abstract

ABSTRACT

Dias, F. F. (Indian Institute of Science, Bangalore, India), and J. V. Bhat. Microbial ecology of activated sludge. I. Dominant bacteria - Over 300 bacterial strains were isolated from seven samples of activated sludge by plating on sewage agar. Gram-negative bacteria of the genera *Zoogloea* and *Comamonas* predominated. Many isolates (51%) showed subanophilic inclusions of poly-βhydroxybutyric acid, whereas 34% accumulated iodophilic material on media containing starch. A large number required either vitamins or amino acids, or both, for growth. None of the isolates tested for their ability to bring about changes in autoclaved sewage produced an effluent comparable in quality to the activated sludge control, although the *Zoogloea* did produce activated sludgelike flocs. A study of 150 bacterial strains isolated from raw sewage revealed that they differed from the sludge isolates in several respects. Coliforms, which constitute nearly a quarter of the sewage isolates, were rarely encountered in sludge.

Descriptors

activated sludge

bacteria

coliforms

Disease/Solid Waste
Abstracts

No. DSW- 56-II

Author

F. F. Dias and J. V. Bhat

Title

Microbial Ecology of Activated Sludge

II. Bacteriophages, Bdellovibrio, Coliforms,

Reference and Other Organisms

Applied Microbiol., Vol. 13, No. 2

Doc. No. Contract No. Date. issu

pp. 257 March 196

Abstract

ABSTRACT

Dias, F. F.....-A comparative estimation of the coliform population of raw sewage, activated sludge, and the effluent derived therefrom revealed that raw sewage had a preponderance of Escherichia coli (75%), as compared with 25 and 30%, respectively, in sludge and effluent. Nitrogen-free mannitol-sucrose enrichments of activated sludge resulted in the isolation of Azotobacter agilis, Aerobacter aerogenes, Corynebacterium laevaniformans, and an Achromabacter species. Sludge had a large population of C. laevaniformans and A. aerogenes but not of Azotobacter. The bacterial parasites, Bdellovibrio and bacteriophages, were not active during activated-sludge treatment. A 10-fold reduction in phage content occurred after 2 hr. of aeration, but the Bdellovibrio population was unaffected.

Descriptors

Escherichia coli
Corynebacterium laevaniformans
A. aerogenes
Azotobacter agilis
Achromabacter species
Azotobacter
Aerobacter aerogenes
C. laveniformans
Bdellovibrio

Disease/Solid Waste
Abstracts

No. DSW-57

Author
M. S. Shahan and J. Traum

Title
The Exotic Zoonoses

Reference
Ann. N.Y. Acad. Sci., V 70, 3 June 1958

Doc. No. Contract No. Date issued
pp. 614-23

Abstract

Insofar as practicable, references to disease covered by other contributors have been omitted in this paper.

As pointed out by Shope (4), there is good indirect evidence to show that swine acquired influenza from man in 1918. An outbreak of influenza virus infection in a ferret colony has been attributed to human sources. ...The lack of proof of human infection with an agent known to be infectious for animals does not preclude the possibility of such a development to a greater or less extent at some future time.

...To be considered is the interesting hypothesis that any animal may be attacked by any infectious agent under appropriate conditions. The growing speed and extenf of world-wide commerce and travel accentuate the danger of the introduction of new diseases, whether they be localized in certain regions or be widespread. Diseases that are exotic or foreign to one area today may become epizootic or epidemic there in a very short time.

Meyer and Hjarre (cited by Wagener (2)) report at least eighty diseases of animals that are transmissible to man. Of these only a very small number are of importance from the standpoint of public health.

In a 265-page booklet entitled *Foreign Animal Diseases* (24), compiled by a committee of the United States Livestock Sanitary Association, Trenton, N.Y., twenty-six more-or-less important exotic animal diseases are listed as follows: African swine fever, Teschen disease, bovine infectious petechial fever, contagious bovine pleuropneumonia, East Coast fever, ephemeral fever, infectious infertility of cattle, lumpy skin disease, malignant catarrh, rinderpest, blue-tongue, contagious agalactia, enzootic abortion, louping ill, Nairobi sheep disease, sheep pox, scrapie, heartwater, nagana, Rift Valley fever, streptothricosis, anthrax, foot-and-mouth disease, Venezuelan equine encephalomyelitis, fowl plague, and Newcastle disease.

Descriptors

zoonoses
influenza
tuberculosis
travel
public health
rabies
foot-and-mouth disease
Newcastle disease
bone meal
birds
*Malleomyces mallei*
melioidosis
Q fever
*Amblyomma americanum*
wild animals
virus

dogs
disease
virus
animal
epizootic
*Mycobacterium tuberculosis*
louping ill
Venezuelan equine encephalomyelitis
spores
infections
sheep
pigs
*Coxiella burneti (R. burneti)*
*Haemaphysalis humerosa*
arthropod-borne encephalitides
Rift Valley fever

cats
swine
ferret
commerce
epidemic
cattle
Rift Valley fever
sheep pox
anthrax
poultry
glanders
goats
*M. pseudomallei*
*Dermacentor andersoni*
*H. bispinosa*
encephalomyelitis
enzootic hepatitis

Abstract (continued)

Of these, only seven (louping ill, Rift Valley fever, Venezuelan equine encephalomyelitis, foot-and-mouth disease, sheep pox, anthrax, and Newcastle disease) are listed as communicable to man.

In 1952 anthrax occurred extensively in animals in some areas of the United States, particularly in the Middle Western states. It is believed that at least one outbreak was caused by the feeding of imported bone meal containing anthrax spores.

Rift Valley fever, sometimes called enzootic hepatitis, an acute, mosquito-borne viral disease of sheep and cattle, has not been identified outside of Africa, where it exists particularly in and near the Great Rift Valley. It causes abortions in animals and is highly fatal, especially to lambs. Shepherds, farmers, butchers, and veterinarians often contract the disease in the course of handling infected animals or carcasses.

Louping ill (24), a viral encephalomyelitis, particularly of sheep and occasionally, of cattle.... Serologically, the virus has been found to be related closely to that of Russian Spring-Summer encephalitis. Similarly, louping ill is tick borne, chiefly by Ixodes ricinus. While the sheep disease has never been diagnosed in the United States, several human infections have occurred in laboratories in the United States (28). Natural infections among humans have also been reported (20,30).

Foot-and-mouth disease (FMD) is an acute, highly communicable disease affecting almost exclusively cloven-footed animals, both domesticated and wild.

Very few cases of FMD in man have been authenticated (31,32) and it has never become a public health problem except as the disease in animals may affect food supplies (milk and meat).... It has invaded the United States nine times since 1870, the last occasion being in 1929. It was last eradicated from Canada in 1953 and from Mexico in 1954.

It is considered appropriate to mention an important aspect of the animal disease problem. ...Notices were sent to laboratories, research institutions, and individuals studying animal diseases to advise that under regulations of the Department of Agriculture it is necessary to obtain authorization by the Secretary of Agriculture for the importation and interstate transportation of certain animal disease organisms and vectors (38). This notice, which was widely published in many scientific journals and other publications, directed attention to the inherent danger of such movements and to the urgent need for precautions against the spread of animal disease.

It is evident that absolute protection against the introduction and dissemination of foreign diseases is virtually impossible; however, every reasonable precaution should be taken toward this end.

Descriptors (continued)

mosquito-borne viral disease
farmers
tick
interstate transportation
foreign diseases

butchers
Ixodes ricinus
vectors
spread of animal disease

shepherds
veterinarians
importation
dissemination

Disease/Solid Waste
Abstracts

No. DSW- 58

Author

H. A. Thomas, Jr., et al

Title

Technology and Economics of Household
Sewage Disposal Systems

Reference

Journal WPCF, V.32, no. 2

| Doc. No. | Contract No. | Date. issue |
|---|---|---|
| p. 113 | | Feb. 196 |

Abstract

Septic Tank Usage

This process and related systems have been and will continue to be satisfactory in areas with suitable types of soil, topography, and other favorable factors. However, there are large sections of the country with impervious soils or otherwise unsuitable conditions where the method has not been successful. The dissatisfaction with the septic tank method derives from four sources:

1. Maintenance by the householder is often erratic or completely lacking. When the absorption system fails, raw or partially treated sewage seeps onto the ground surface and may become a nuisance and a public health hazard.

2. All soil, except the most pervious formations, will become clogged with the solid organic and inorganic residues of stabilized sewage.

3. The present state of design as regards the absorption area requirement per person is not satisfactory. In some regions it is difficult to predict with precision the capacity of a given soil for receiving effluent. Designs based on fresh water percolation tests in current use are frequently wide of the mark.

4. . . . most systems are installed without adequate attention to design and construction because of the high cost of adequate exploration of the soil and subsoil which may require soil borings as well as leaching tests. . . . the use of the septic

Descriptors

household sewage
septic tank
impervious soil
absorption system
sewage
disposal
aerosol production
water-borne disease
coliform removal
research
soil clogging
health hazard
soil
solid organic
inorganic residues
effluent
evaporation
transpiration
health hazard
coliform
development
percolation tests
soil borings
leaching tests
self purification
ground-water contamination
per capita cost
household aerobic sewage treatment devices
health
sanitation

## Abstract (continued)

tank and absorption field system has resulted in unhygienic and uneconomical practices in many communities.

Some authorities have stressed the lack of knowledge at present of factors governing the self purification of ground water and the persistence of ground-water contamination.

. . . there exist only three posibilities for the ultimate disposal of treated sewage effluents from individual households: the effluent can be discharged (wholly or in part) (a) into the soil where eventually it will join the ground water or be evaporated; (b) onto the ground surface and to natural drainage, if any; and (c) to the air by aerosol production, evaporation, and transpiration.

The cost of sanitary sewerage is closely dependent on population density. The per capita cost in many situations varies approximately inversely as the square root of the areal density of population. According to this rule, the cost per person of sewerage in a zoning area with minimum lot sizes of one acre is approximately three ( $\sqrt{43,560/5,000}$ times that of zones with lots averaging 5,000 sq ft.

The development of household aerobic sewage treatment devices, which derives primarily from the work of Bllodgood (6), Perry (7), and Rigby (8), is an important forward step in sanitary engineering practice. Criteria for the design and the delimitation of the use of these devices have been reported by committee studies (9).

Existing experience, however, is not sufficient to establish the extent to which these treatment devices reduce the hazard of water-borne disease.

. . . coliform removal performance is by itself not sufficient to establish firmly the degree of health hazard associated with various schemes of disposal of the effluent; . . .

The most reliable data relating to coliform removal efficiency of individual household aerobic sewage treatment systems indicate that these units yield coliform densities in excess of those which have been considered tolerable for surface discharge in areas accessible to humans.

From the health viewpoint it is recognized that during the interval between the time of failure and time of repair of a system there is apt to be a health hazard to the community.

**Abstract (continued)**

Research Research

. . . (a) an intensive research and development program to advance the technology of sewage disposal for metropolitan fringe areas is needed; and (b) until such time as the results of this program have become firmly established, conservative, time-proven sanitation objectives should be rigorously maintained in these areas.

List of Research Projects

1. Continued development of new and modified on-lot treatment methods.

2. Development of a practicable individual household sewage disinfection (oxidizing chemicals automatically dosed or possibly generated by electrolytic decomposition of sewage and brine; pasteurization is a possibility, perhaps coupled with heat treatment to speed stabilization).

3. Quantitative assessment of factors governing the self-purification of polluted ground water and the persistence of ground-water contamination. Particular attention to the fate of synthetic detergents discharged into ground-water strata.

4. Evaluation of the amount of evaporation and transpiration occuring in various types of soil absorption systems under different climatic conditions. Investigation of methods and designs to speed evaporation.

5. Fundamental investigation of the soil clogging process in absorption fields.

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(6) Bloodgood, D. E., "A New System for Home Sewage Disposal." Presented before the Engineering Section of the American Public Health Association, Cleveland, Ohio, Oct. 23, 1952.

(7) Perry, R. R, "Adoption of an Aerobic Sewage Treatment Process for Individual Homes." A Thesis, Purdue Univ., Lafayette, Ind. (Aug. 1951)

(8) Rigby, L. E., "Aerobic Treatment of Sewage for Individual Homes and the Reuse of the Treated Waste Water for Toilet Flushing." A Thesis, Purdue Univ., Lafayette, Ind. (Jan. 1954).

(9) "Report on Individual Household Aerobic Sewage Treatment Systems." Subcommittee on Waste Disposal of the Committee on Sanitary Engineering and Environment, Publication 586, Natl. Acad. Sci. - Natl. Research Council, Washington, D. C. (1958).

Disease/Solid Waste
Abstracts

No. DSW- 59

**Author**

Michael B. Shimkin, B. K. Koe, & L. Zechmeiste

**Title**

An Instance of the Occurrence of Carcinogenic
Substances in Certain Barnacles

**Reference**

Science, Vol. 113 1951

| Doc. No. | Contract No. | Date. issue |
|---|---|---|
| p 650 | | |

**Abstract**

The chromatographic fractionation of some extracts obtained from a sample of the thatched barnacle (Tetraclita squamosa rubescens) showed on lime and alumina columns the presence of several zones that displayed intense blue fluorescence in ultraviolet light. Some of the fractions were crystallized and gave in hexane solution extinction curves that were typical for polycyclic aromatic hydrocarbons. Furthermore, a spectroscopic examination, although also indicative of accompanying isomers or close analogs, demonstrated the presence of 3, 4-benzpyrene in the crystalline mixture.

Comparative work on barnacles has shown that the polycyclic aromatic hydrocarbons do not constitute normal metabolic products but may reach these organisms accidentally. The possibility of tarry materials, from ships or submarine oil wells, being carried to the filter-feeding intertidal sedentary animals constitutes a potential external source for aromatic polycyclic hydrocarbons.

**Descriptors**

Tetraclita squamosa rubescens
3, 4-benzpyrene
barnacles
tarry materials
sedentary animals

Disease/Solid Waste
Abstracts

No. DSW-60

Author

WC Reeves, RE Bellamy, AF Geib, & RP Scrivani

Title

Analysis of the Circumstances Leading to Abortion of a Western Equine Encephalitis Epidemic

Reference

AM. J. Hyg. 1964, V. 80:205-220

Doc. No.
Contract No.
Date issued

Abstract

In Kern County, California, in 1958, 15 WEE and 2 SKE human cases were confirmed.

SUMMARY

In the early summer of 1958 epidemiologic circumstances were conducive to the development of a western equine encephalitis (WEE) epidemic in Kern County, California. The coincidence of a spring rainfall much greater than normal and a river flow approaching flood level through early summer provided extensive areas favorable for Culex tarsalis breeding and resulted in an immense vector population by early summer.

In late May WEE virus infection rates reached levels of 9.5 per 1,000 C. tarsalis and remained at high levels for 5 months; however, only a small proportion of infected C. tarsilis was capable of transmitting virus until the end of June. There were 15 confirmed WEE cases and 2 confirmed SLE cases in man and 17 suspected WEE cases in horses. Thus, despite the epidemic potential, the WEE attack rate in the human population was significantly lower than in other epidemic years.

Observations were made of vector population changes, the incidence and prevalence of virus transmission to avian hosts, the distribution of human cases by onset date and geographic location, the immunity status of the human population, climatic factors, and the efforts to control the vector population. From these observations we concluded that the magnitude of the epidemic was limited by a combination of low temperatures in the early summer that delayed extrinsic incubation of virus in C. tarsalis and successful control of the vector population in the urban area by midsummer

Descriptors

vectors
mosquitoes
encephalitis

Disease/Solid Waste
Abstracts

No. DSW- 61

Author

Findlay E. Russell & Paul Kotin

Title

Squamous Papilloma in the White Croaker

Reference

J. of the Natl. Cancer Inst. Vol. 18, No. 6

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| June 1957, pp. 857 | | |

Abstract

The pollution of rivers, streams, and coastal sea waters, with industrial effluents containing carcinogenic hydrocarbons, theoretically introduces a potential environmental hazard. In view of the reported paucity of spontaneous tumors in marine animals from their natural habitat, the occurrence of papillary lesions on the lips of several fish, collected from polluted Pacific waters off the southern California coast, is worthy of comment.

The observation is significant that 10 of the 353 white croakers, taken from waters approximately 2 miles from the outfall of a sewage-treatment plant, bore lesions about the mouth In contract, no similar lesions were noted in 1,116 white croakers taken from nonpolluted waters 50 miles away Lucke and Schlumberger (14) noted that nearly all of the affected catfish in their study were from the grossly polluted Schuylkill and Delaware Rivers. These investigators could not exclude the possibility that the lesions were induced by chemical carcinogenic agents in the water.

The pollution of water with known and suspected carcinogenic agents, incidental to the industrialization of society, was suspected by Hueper in 1942 (15). During the intervening years this suspicion has been confirmed. Furthermore, tumors have been demonstrated in marine animals taken from a polluted aquatic environment.

The findings herein reported serve to emphasize the need for additional studies of polluted marine waters.

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(14) Lucke, B., and Schlumberger, H.: Transplantable epitheliomas of the lip and mouth of catfish. I. Pathology Transplantation to anterior chamber of eye and into cornea. J. Exper. Med. 74: 397-403, 1941.

(15) Hueper, W. C.: Occupational Tumors and Allied Diseases. Springfield, Ill., Charles C. Thomas, 1942, pp. 5 and 33.

Descriptors

carcinogens
carcinogenic hydrocarbons
environmental hazard

Disease/Solid Waste
Abstracts

No. DSW-62

Author

L.A. Allen, Eileen Brooks & Irene L. Willia

Title

Effect of Treatment at the Sewage Works on the numbers and types of Bacteria in Sewage

Reference

Jrl. of Hygiene, V. 47, 1949, pp. 303

Doc. No. Contract No. Date issued

Abstract

SUMMARY AND CONCLUSIONS-

Though the average total numbers of bacteria in the sewage containing trade wastes were appreciably higher than that of the domestic sewage the counts of faecal organisms were somewhat lower.

Treatment at the works considerably reduced not only the polluting strength of the sewage but also the numbers of bacteria.

The final effluents discharged from the works still contained large numbers of bacteria Their effect on the bacterial content of the streams to which they are discharged may be gauged from the fact that, in the effluent from the small rural sewage works, which was of consistently good quality when judged by chemical criteria, there were on the average about 160,000 cells of faecal Bacterium coli and about 20,000 faecal streptococci per 100 ml. Numbers in the effluent from the works in the industrial town were even higher. Sand filters of the type investigated here could therefore not be relied upon to produce an effluent of good bacterial quality.

Descriptors

trade wastes
sewage
bacteria

Disease/Solid Waste Abstracts

No. DSW-63

Author

Philip Wedgewood & Ronald L. Cooper

Title

The Detection & Determination of Traces of Polynuclear Hydrocarbons in Industrial Effluents & Sewage, Part II. Sewage Humus & Treated Effluents

Reference

Analyst, V. 79, March 1954, p. 163

Doc. No. Contract No. Date issued

Abstract

Effluents discharged from gasworks into the sewers can be an important source of aromatic compounds, and washings from macadam roads may also make a contribution, but recent work indicates that another source is the atmosphere, whence they are deposited or washed by rain and snow.

When for a variety of reasons the biochemical oxidation of the impurities in the sewage is not efficient, the amounts of hydrocarbon present in the humus and final effluent appear to be higher than usual.

Careful analysis of human urine faeces has failed to reveal the presence of these complex hydrocarbons and therefore sources other than domestic sewage are indicated.

Descriptors

polynuclear hydrocarbons
industrial
effluents
sewage
solid waste residue
humus

No. DSW-64

Author

Badgasarian, G.A.,

Title

**Sanitary & Virologic Examination Soil & Vegetables in Irrigation Fields.**

Reference

Sewage & S. Sediment Fertilization

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Gigiena I Sanitariya, 29:37-9, Nov 1964 | | |

Abstract

During 1962-1963 the soil and the vegetables from the irrigation fields of two state forms, using sewage and sewage sediment for fertilization purposes, underwent sanitary and virus examinations. Of the 137 soil samples examined, 8 proved to contain enteroviruses (ECHO 7-9 and a combination of polioviruses, Type I, II and III). Moreover, enteroviruses were isolated form 2 samples of vegetables from the irrigation fields and from 2 samples of sewage and sewage sediment. A definite prevalence of virus ECHO in the soil was noted. The data obtained show that the presence of enteroviruses in the sewage and the sewage sediment used for irrigation purposes brings about the contamination of the soil on the irrigation field with enteroviruses and, consequently, makes the contamination of the cultivated vegetables possible as well. In this connection, the soil and the vegetables from the irrigation fields should undergo periodical sanitary examination for the presence of enteroviruses.

Descriptors

virus
sludge
fertilizer
contamination (food)

Disease/Solid Waste
Abstracts

No. DSW- 65

Author

E. P. Taiganides, R. E. Baumann & T. E. Hazen

Title

Sludge Digestion of Farm Animal Wastes

Reference

Compost Science, Summer 1963, pp. 26

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Abstract

Perhaps the largest single problem resulting from the recent increase in confinement rearing of livestock and poultry involves wastes handling and disposal. The odor and fly nuisance of the wastes, the large volumes of daily production, the decline of manure as a competitive fertilizer and the encroachment of urban areas close to production units complicate the problem of waste handling, treatment and disposal.

The value of digestion of animal wastes lies in the utilization of the methane gas and in the production of an end product that is more desirable than the raw manure. The gas produced can be used to heat the farm buildings, to generate electricyt and to run converted gas engines. The major disadvantage of sludge digestion as a treatment of animal wastes is the high initial investment.

Descriptors

sludge digestion
farm animal wastes
fly nuisance
odor
manure
fertilizer

No. DSW- 66

Author

J. M. Foliguet et L. Schwartzbrod

Title

Research on Viruses found in Sewage and Drinking Water in Meurthe and Moselle I. The Purposes methods, and preliminary results.

Reference

Rev. Hyg. et Med. soc., 1965, t 13. No. 2

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pp. 137-162 | | |

Abstract

SUMMARY-The authors recall in particular the epidemiological renewal of hydric transmission illnesses due to enteroviruses and the importance of residuary waters as virus reservoirs and viral pollution factors of the outside world.

From October 1961 to June 1963, on 560 samples, 83 enterovirus strains have been isolated in the following way:

64 out of 245 (26.1%) from drains
11 out of 214 (5.14%) from rivers
8 out of 101 (7.9%) from drinking water

The rivers Meurthe and Moselle are constantly polluted the whole year round by drain water that is poured into them without any previous treatment.

Enteroviruses can pass the barriers of filtrating apparatus without much difficulty, which makes a constant watch on the means of purification necessary on the functional side.

Descriptors

drinking water
pollution
rivers

Disease/Solid Waste
Abstracts

No. DSW- 67

Author

H.J. Cahnmann & Masanori Kuratsune

Title

Determination of Polycyclic Aromatic Hydrocarbons in Oysters Collected in Polluted Water

Reference

Analytical Chemistry, V.29, No. 9, Sept. 1957

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pp. 1312 | | |

Abstract

As barnacles take up polycyclic aromatic hydrocarbons from polluted surroundings, it was of interest to know whether other marine animals living in water polluted with petroleum oils or tars also contain such hydrocarbons. As an investigation of edible marine animals is of particular practical interest, oysters collected in a moderately polluted harbor area were chosen for the present investigation. The investigation led to the detection of a number of polycyclic aromatic hydrocarbons. They amounted to about 1 mg. per 1 kg. of shucked oysters.

The oysters used in the present investigation were collected in an area which was only moderately polluted with petroleum oils. There was no evidence of tar pollution. It must be assumed that the quantities of polycyclic aromatic hydrocarbons in oysters vary, as in barnacles, with their habitat. The significance of the quantitative results presented in this paper can therefore not be evaluated until several batches of oysters collected at different locations have been analyzed. Qualitatively, the present investigation shows that oysters, like barnacles, are able to take up polycyclic aromatic hydrocarbon from polluted surroundings.

Descriptors

barnacles
polycyclic aromatic hydrocarbons
marine animals
polluted
petroleum oils
tars
oysters

Disease/Solid Waste
Abstracts

No. DSW-68

Author

Nelson L. Nemerow and John C. Bryson

Title

How Efficient are Oxidation Ponds?

Reference

Wastes Engineering for March, 1963, pp. 133

Doc. No. Contract No. Date issued

Abstract

A one-year study of two waste stabilization ponds in series at Hancock Air Force Base near Syracuse, N.Y., showed that:

...Loadings averaging 130 pounds of BOD per acre per day were satisfactorily treated

...BOD removals averaged 69.3 percent in the first pond and 88.3 percent in the two ponds.

...Suspended solids reductions were 65 percent in the first pond and 83 percent in the two ponds

...Coliform organisms were reduced 99 7 percent, at an average influent count of 133,000,000/100 ml.

...No direct correlation existed between loadings and pond efficiencies.

...Sludge accumulations in the first pond reduced the effective depth by 22 percent in a 32-month period.

...Objectionable odors were practically nonexistent at the ponds and were not perceptible 50 yards away.

The appearance of the ponds and the surrounding area was fair to poor throughout the study. Screenings from the bar racks were dumped in and on the banks of the first pond. Heavy vegetation existed around the shore and on the edtes of both ponds. The second pond was infested with cat tails, marsh grass, small trees and weeds. This preponderance of vegetation in and on the banks of the ponds constitutes a potential additional organic load to the ponds.

Mosquitoes were prevalent during the summer months, but were controlled by spraying. The wild life present was generally not of the nuisance type, except for the rats and muskrats. Measures to eliminate these animals should be taken,

Descriptors

oxidation ponds
sludge
bacteria
water
bod removals
coliform organisms

Abstract (continued)

since muskrats may cause extensive damage to the banks and dikes of the ponds.

The average rate of evaporation was determined to be 9,840 gpd. The seepage was found to be approximately 25,000 gpd in the first pond. Seepage and evaporation rates amounted to approximately 29 percent of the influent flow.

Disease/Solid Waste
Abstracts

No. DSW- 69

Author

Gerald Berg, PH.D.

Title

The Virus Hazard in Water Supplies

Reference

New England Water Works Assoc. June 1964, No.2

Doc. No. Contract No. Date issued

pp. 79

Abstract

SUMMARY - Flocculation alone may effectively remove large quantities of virus from waters. Rapid sand filtration alone is ineffective. Slow sand filtration, uncommon in this country today, may be more effective.

High pH levels may be effective in destroying viruses, but complete data on the practicability of this procedure are not yet available. Certainly, the use of high pH levels must be weighed carefully against the reduced microbicidal activity of chlorine (Figure 6-8) in any subsequent disinfection procedure.

While some of these treatment methods are effective in removing and destroying viruses, none appear capable of insuring a virus-free water before and during distribution.

It seems axiomatic, at the present time, that only adequate disinfection can be depended upon to do this.

Descriptors
virus
water supplies

Disease/Solid Waste
Abstracts

No. DSW- 70

Author
D. A. Okun, et al

Title A Review of the Literature of 1964 on Wastewater and Water Pollution Control

Reference
Journal WPCF

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Vol. 37, No. 6 , pp. 735 | | June 1965 |

Abstract

Dougherty has made an additional pilot-plant model study of the activated sludge process in treating citrus-processing wastewaters. When the system was operated at optimum BOD loadings for sludge production but was not overloaded, more that 20 percent of the total solids in the untreated waste were recovered as dry excess sludge.

Cessna (1) wrote that in 1959 the residents of Modesto, Calif., totaled 30,000 while the peak industrial waste loading from food processing was a population equivalent of 450,000. In less than 5 yr, with an increase in population of only 2,000, the peak industrial waste loading has reached a population equivalent of 794,000, a 76-percent increase.

To produce and refine a single pound of food for the American housewife requires that 5 to 10 lb (2.3 to 4.5 kg) of solid waste material be left in the field or processing factory. Livestock produce 6 to 25 lb of manure/lb of weigt gained, or a total of 1.09 bil cu yd/yr (0.83 bil cu m/yr of manure. The management of manure is a serious technical problem facing the farmer today, as is the disposal of solid waste residues from food producing. The need for an integrated approach to waste management is nowhere more evident than at the so-called (urban-rural zone of contact." Two principal approaches now seem imperative, namely, a program of education of the citizen, his elected representatives, and the food producer and processor, and a program of research into economical and technologically feasible methods of community waste disposal. The solution will come only when coordinated system are developed that will give society its desired level of sanitation, and when the citizenry is convinced of the necessity of paying for it. Of the citrus crop about 45 percent of the fruit is peel, pulp, and seed.

Beet sugar wates consisted primarily of sucrose (95 percent). Wastes from the manufacture of potato starch: Suspended pulp contributes approximately half of the total BOD. The remainder of the BOD essentially consists of soluble proteing.

Milk separator sludge: Although the sludge was sterile and seemed to be an excellent source of albumin, Eichel (17) did not recommend this product for animal

Descriptors
wastewaters
solids
sludge
waste constituents
coffee and tea
manure
citrus crop
root vegetables
baby-food
beet sugar wastes
potato starch
cane sugar
dairy wastes
cheese plant
pharmaceutical waste sludge
vinylacetate
alcohol industry
olefins
AcOBu
butyl alcohol
acrilonitrile
copper napthenate
polysulfide rubber
synthetic rubber
polyvinyl chloride
perfume manufacture
organic chemical industry
sodium soaps
lubricating greases
synthetic resins
petrochemical wastes
coal wastes
Cyanide and plating wastes
pulp and paper mill wastes
tannery, textile and wool
scouring wastes
wool
cotton
tanrery wastes
industrial wastes-
radioactive

feed because of the risk of recontimination during mixing and feeding and the subsequent growth of harmful microorganisms in the moist product.

Three-stage anaerobic-aerobic pond systems treating wastes from small rural abattoirs in Louisiana were described by Coerver. 1. Coerver, J. F., in "Industry's Idea Clinic." This Journal, 36, 8, 944 (Aug. 1964). All wastes are discharged to these systems including blood, grease, and paunch manure.

The compositng of vacuum-filtered pharmaceutical waste sludge at American Cyanamid's Pear River plant was reported by Friedman.6.Friedman, J. H., "Safe Disposal of Waste Solids." Compost Science, 4, 5 (1963). Madera et al. (28) have examined the quantity and composition of wastes from pharmaceutical plants manufacturing chloramphenicol and lobeline. The wastes also contained methanol and other by-products; they were highly odorous because of small qualtities of pyridine. Concentrated wastes can be separated at the manufacturing plant, and disposed of by burning. 28. Madera, V., Solin, V., and Spaeck, M., "The Removal of Wastes from Pharmaceutical Plants Effluents." Sbornik VSCHT Oddil Technol. Vody (Czech.), 6, Part 1, 57 (1962); Pub. Health Eng. Abs., 44, 1959 (1964).

The use of pulverized coals has added greatly to the quantities of fly ash produced (15 mil metric tons/yr in the U. S. alone). Characteristics of fly ash were discussed, and uses were described in concrete, in soil stabilization, in asphalt paving mixes, in making lightweight aggregates, and in other applications.

Pickling Wastes; Acid and alkaline wastes are mixed and limed if necessary. Residues are dried with hot air, and then dumped. Concentrated acid wastes were treated with excess of lime added. The sludges were discharged continuously onto a belt conveyor for dumping. Deep-well disposal of waste acids has continued to attract attention. Baker (1) discussed construction and maintenance of wells, including well grouting, sealing, fracturing, and acid addition. Talbot and Beardon (11) summarized development of such wells in the United States, where there are now over 50 wells. This disposal method has proven to be versatile, safe, and permanent. 1. Baker, W. M. "Waste Disposal Well Completion and Maintenance." Incl. Water and Wastes, 8, 6, 43 (1963). 11. Talbot, J. S. and Beardon, P., "The Deep Well Method of Industrial Waste Disposal." Chem. Eng. Progr., 60, 49 (1964). Waste stainless-steel pickle liquors: The sludge is mixed with soda ash and sintered to metallic oxides, mainly iron, nickel, and chromium.

Cyanide and Plating Wastes: The best research work on cyanide and plating wastes was done in the realm of biological activity.

Pulp and Paper Mill Wastes: Knowlton (42) reviewed National Council for Stream Improvement and paper industry research activities in stream analysis, sludge disposal, aquatic biology, BOD reduction, color removal, and sulfite liquor recovery. 42. Knowlton, D. C. "Progress in Pollution Abatement and Water Conservation." Tappi, 47, 11, 16A (1964).

Borger (13) found that ash from mill-scale burning of 55 percent solids sulfite liquor yielded an ash containing 59 percent calcium sulfate, 36 percent calcium oxide, and 2 percent calcium carbonate. The ash sinters at 1,100°C but does not melt at 1,650°C. Electrostatic precipitators remove 90 percent of the entrained ash. 13. Borger, H. E. A. "Combustion of Spent Sulfite Liquor to Prevent Water Polution." Papier (Germany), 18 267 (1964); abs. Bull. Inst. Pap. Chem., 35, 1151 (1964).

Edde (28) reported the results of a National Council survey of 55 primary clarifier operations. Data on total and settleable suspended solids and on BOD removal were presented for seven mill groups, including box-board, tissue, fine papers, de-inking, integrated pulp and paper, bleached kraft, and newsprint mills. Settleable solids and total suspended solids removals range from 90 to 99 and 65 to 80 percent, respectively. 28. Edde. H., and Gehm, H. W., "Settleable Solids and Removal Practices in the Pulp and Paper Industry." National Council for Stream Improvement Tech. Bull. 178 (Nov. 1964).

Carpenter (18) studied mechanical pressing of boardmill and de-inking sludge filter cakes containing 20 and 30 percent solids. Filter cake is dried and burned in a rotary kiln at 1,200°F (650°C). 18. Carpenter, W. L. "Mechanical Pressing of Primary Dewatered Papermill Sludges." National Council for Stream Improvement Tech. Bull. 174 (June 1964).

Cotton: Various methods of disposing of excess activated sludge were described.

Tannery Wastes: Some of the problems associated with mechanical removal of settled materials were reviewed by Malek and Ludvik (9). Solids reuse in agriculture, including a discussion of the effect on various crops, was covered. 9. Malek, M., and Ludvik, J., "Some Problems of Mechanical Treatment of Tannery Waste (1) A Description of Plant, Removal of Insolubles, and Sedimentation." Veda Vyzkum Prumyslu Kozedelnem (Czech.), 7, 63 (1963); Chem. Abs., 60, 11743 (1964).

Jansky (13). recovered hair, flesh, shavings, and other coarse materials which could be removed by skimming channels before sedimentation. This material could be disposed of by drying and burial, composting, vacuum filtration, or filter pressing. 13. Zansky, K., "Sludge Processing in Tannery Waste Waters." Veda Vyzkum Prumyslu Kozedelnem (Czech.), 7, 91 (1963); Chem Abs., 60, 14248 (1964).

Disease/Solid Waste
Abstracts

No. DSW- 71

Author

GlenE. Browning & John J. Gannon

Title

Operator Protection in Wastewater Treatment Pla

Reference

J. Water Poll Control Federation, Feb. 63

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 186 | | |

Abstract

A survey made by the California State Department of Public Health in 16 north coastal counties of the state has shown that persons working in wastewater disposal plants have fewer job-related injuries than do persons working in industrial plants generally.

The California survey was made in 200 wastewater systems in northern California to determine the health and safety conditions affecting operators. Observations were made of features relating to physical safety, prevention of operator sickness and body infection, prevention of burns, explosions, asphyxiation, and poisoning, and the handling of chlorine.

Survey Findings - There are 572 operators employed at the wastewater treatment plants studied. During the 12 mo period preceding the survey there were 38 job-related injuries. No deaths were reported. There were two cases of asphyxiation and one possible job-related infection.

On the matter of physical safety, the items most frequently found at fault were the lack of adequate lighting at night, rope and safety belts not being used by operators in deep pits, no safety hoops on vertical ladders, and the use of portable lean-to ladders.

At more than the half the plants the operators do not receive regular typhoid and tetanus inoculations.

Descriptors
operator
wastewater treatment plants
safety
workers

**No. DSW-**72

**Author**

**Title**

Research on Zoonoses

(Study on animal vectors)

**Reference**

W.H.O. Chronical, 19 (3):101-106 1965

| **Doc. No.** | **Contract No.** | **Date issued** |
|---|---|---|

**Abstract**

The epidemiology of leptospirosis is influenced to a great extent by the biotic as well as the physical environment, since the principal hosts of leptospires are animals living in infected localities. In most cases these animals are wild or domiciliary rodents, but collaborating laboratories in North America have recently reported the important role of wild ruminants (deer), and reservoirs of the infection.

As far as is known, the dog is the main reservoir of Echinococcus granulosus and a difficulty in eliminating this source of infection is that no efficient anthelmintic is available.

**Descriptors**

rabies
influenza
wild or domiciliary rodents
reservoirs
dog
zoonoses
virus infections
wild ruminants
parasitic zoonoses
Echinococcus granulosus
Brucellosis
Leptospirosis
deer
hydatidosis

Disease/Solid Waste
Abstracts

No. DSW- 73

Author

Uhl T. Mann

Title

Safety in Sewer and Treatment Plant Operation

Reference

Doc. No. Contract No. Date issued

J. WPCF, V. 35, No. 2, Feb. 1963, pp. 222

Abstract

The injury frequency rate of all industries is reported as 6.38. Many are much lower, but the rate for sewer departments is 32 9, well above the rates for such industries as construction (19.10) and coal mining (23.07). It does not seem that sewer department work is inherently more dangerous than work in the steel, chemical, or construction industries, all of which have lower injury frequency rates. It must, therefore, be inferred that the high injury rate experienced by sewer departments is due to (a) lack of adequate protective devices, (b) insufficient knowledge of safety practices on the part of the employee, or (c) failure of employees to take a genuine interest in safety, or, more probably, (d) a combination of all three factors.

TABLE I

Industry Injury Frequency Rates

(in part)

| Industry | Freq. Rate (disabling injuries per million man-hr worked) |
|---|---|
| Sewer departments | 32.90 |
| Sanitation (trash & garbage collection) | 39.70 |

A breakdown according to accident source should prove useful. The results of this breakdown for the Onondaga County department are compared with similar data on industry-wide injuries in Table II.

The parallel between these two sets of data is striking, thus helping to point out that accidents are caused by the same conditions or the same type of carelessness.

Descriptors

**safety**
**sewer and treatment plant**

Disease/Solid Waste
Abstracts

No. DSW- 74

Author

Willard W. Becklund

Title

Revised Check List of Internal and External Parasites of Domestic Animals in the U.S. and Possessions and in Canada

Reference

Amer. J. of Veterinary Research, 9/64, 25,108

| Doc. No. | Contract No. | Date issue |
|---|---|---|

Abstract

A checklist of parasites of domestic animals in the United States and states where they occur are as follows:

host species
location in hosts
intermediate hosts, if any.

A few words of explanation concerning the "scientific names are necessary. Some species have been placed in more than one genus, and each of the resultant combinations of generic and specific names is recognized currently by various authorities. The authority followed will frequently determine whether the scientific name of a parasite will be familiar or unfamiliar to most readers.

Descriptors

**disease**
**animals**
**parasites (domestic)**

Disease/Solid Waste
Abstracts

No. DSW- 75

Author

Dale R. Lindsay & Harvey I. Scudder

Title

Nonbiting Flies and Disease

Reference

Annual Review of Entomology, Vo 1, 1956

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 323 | | |

Abstract

The nonbiting flies are probably responsible for the transmission of the causative agents of many more cases of enteric bacterial infections, of all types, than are biting flies, including mosquitoes. Certainly this is true in the United States where infection rates, if not disease, are low in comparison to those of the rest of the world. From surveys conducted in New Mexico, Georgia, Pureto Rico, and New York City, Watt & Hardy (1) showed that Shigella infections predominated, their studies indicating total reported or estimated annual morbidity rates of 48 percent in New Mexico, 20 percent in Georgia, 60 percent in Puerto Rico, and "markedly less" in New York City. They also found that

> ...for every known infection (manifest source) there are numerous unrecognized infections (hidden sources). In the light of these findings it is not surprising that endemic diarrheal diseases commonly appear to be scattered sporadic cases. These seemingly unrelated infections may arise from a single source or be joined by a series of undetected infections This knowledge is essential for the interpretation of the epidemiology of the acute diarrheal diseases.

In many tropical and subtropical areas devoid of modern sanitation, the principal factor influencing the spread of disease agents by flies and other means is the degree to which the etiologic agents themselves are present. This is also true in amny marginal areas with inadequate sanitation and may likewise occur in areas of normally high standards during temporary disruptions of sanitation facilities following disaster. Atomic warfare, for example, would create such disruption on an unprecedented scale.

The authors are following West's example in omitting critical evaluation of the early work as it is believed that this would involve too much speculation to serve any real purpose.

Much of the work preceding World War II on the passage of organisms

Descriptors
**Nonbiting**
**flies**
**disease**

Abstract (continued)

through flies was performed in England during the few years immediately before World War I. Not only were bacteriological techniques and taxonomy relatively undeveloped at that time, but little was recognized of the complexity of the problem involved Thus controls on the experiments were generally inadequate, and the organisms involved are now impossible to identify in modern terms.

By way of comparison, the earliest work on the ability of flies to serve as mechanical vectors is probably as significant today as when it was done.

In spite of evidence demonstrating the ability of the various nonbiting flies to carry disease agents, and of observations showing the association of an abundance of flies with increased prevalence rates of various diseases, chiefly enteric, there existed prior to 1946 no experimentally derived proof of the true role of flies in the spread of any pathogen. West (2) points out the circumstantial evidence involved in fly vectoring and reports the pre-World War II statements of several workers to the effect that flies were probably only supplementary to a more common form of transmission in most diseases.

A poliomyelitis epidemic occurred in an area where fly control was being carried on to study its effect upon enteric infections (8). In spite of the maintenance of high degrees of fly control in four of nine towns in Hidalgo County, Texas, the rates of paralytic cases were nearly identical in towns with and without fly control. In addition, epidemiological investigations revealed that the attack rate per 1000 was 12 times as high among individuals with histories of contact with recognized cases of poliomyelitis as in individuals with no histories of contact, regareless of fly treatment status of the area of residence. This study was conducted in Hidalgo County, Texas in 1946 to 1948. Fly control was achieved with DDT spraying in five out of nine similar towns. It resulted in substantial reductions in (a) Shigella infections, as determined by rectal swab cultures in representative groups of children under 10 years of age (b) reported attacks of diarrheal disease, and (c) reported deaths of children under two years of age. In september, 1947, after nearly 20 months of fly control in five of the nine study towns, the treatment order was reversed, and the four previously untreated towns were subjected to fly control measures with DDT. This change in schedule coincided with the normal seasonal increase in flies in the area and within a few days the Scudder fly grill indices (24) for the previously treated towns had risen sharply. This was followed a few weeks later by a comparable condition in the rates of cultured infections of Shigella and of reported diarrheal disease. Concurrently with these rising trends, fly indices for the currently treated towns abruptly declined. This reversal in trends, coinciding with the change in fly controlled areas, decisively eliminated the possibility of chance and demonstrated the role of flies in vectoring a human disease in this study area and under the conditions involved.

The experience in Hidalgo County, an area of high diarrheal disease morbidity, was duplicated in 1949 and 1950 in Thomas County, Georgia. A similar reduction in diarrheal disease morbidity was found to follow fly control. Mortality rates, however, were too low to be properly evaluated.

Many studies on shigellosis have been carried out by the United States Naval Medical Research Unit Number 3, Cairo, Egypt. Higgins & Floyd (26), of this unit, reported studies on the distribution, chemotherapy, and immunological aspects of shigellosis in rural towns in Egypt.

Abstract (continued)

The fly prevalence was effectively controlled by insecticides in 1950, and infant mortality dropped from 227/1000 live births in 1949 to 115/1000 in 1950. In 1951, however, the fly population became resistant to chlordane and DDT, and returned to its former level. Infant mortality also again resumed its previous level. A large part of the salvage of infant life during the period of fly control was attributed to control of fly-borne disease.

In the Georgia study, as in the preceding Texas study, a notable and surprising failure to demonstrate any role of flies in the transmission of salmonellosis bacteria is still unexplained.

Man's infections with Salmonella are believed to stem usually from infected eggs, meats, or meat products in which natural infections have had opportunities to incubate and reproduce. Such situations are usually found in instances of large outbreaks of salmonellosis.

Other studies of nonbiting flies associated with human disease have involved the chloropid eye gnats (Hippelates spp.) and their seasonal abundance coincidental with "pink eye" or infectious conjunctivities. The Koch-Weeks bacillus, now identified as Hemophilus aegptius, and H. influenzae were present in a significant number of cultures from "sore eyes." Dow (38) demonstrated the feasibility of Hemophilus transmission by Hippelates.

Continuing studies have shown markedly positive correlations between the numbers of Hippelates collusor, the dominant species present, and all school absenteeism Earlier work had demonstrated that "sore eyes" were considered the primary cause of school absenteeism in the area.

Muirhead-Thomson (40) reported in 1954 that Siphunculina funicola coincides in seasonal incidence with Maga sore and epidemic conjunctivitis in Assam India.

Studies of yaws in western Samoa by Satchell & Harrison (42) have pointed most convincingly to the transmission of the spirochaetes of this disease in part by wound-feeding flies. They considered the prerequisites for yaws transmission by Musca domestica and Musca sorbens to be amply demonstrated by their work.

The caustive agents of some 30 diseases in all have been associated with or demonstrated by laboratory techniques to be capable of transmission by nonbiting flies. Without indicating the degree of importance, it may be said that flies constitute one mode of transmission for the agents of such diseases as cholera, and various protozoan and helminth infections.

The foregoing accounts of the demonstrated role of flies in vectoring shigellosis under certain conditions and the lack of such demonstration for other infectious diseases are admittedly confusing; nor is the end to the confusion in sight.

Many variable factors are also recognized as possible causes of the diverse results obtained by different workers.

The diverse findings shown indicate the need for systematic studies of the conditions that promote or inhibit the survival, multiplication, and passage of various microorganisms.

Acceptance of fly control and prevention as a public responsibility has been extremely slow even in the more prosperous sections of the United States Little money has as yet been authorized for fly control on either a vector or pest basis though flies are a major problem in most areas.

The control or prevention of flies requires such intimate intervention

Abstract (continued)

into the residential lives and habits of the people and the design of their agriculture and industries that satisfactory reductive methods have not been developed. The advent of DDT made possible a method of control which could overlook the basic need for drastic improvement in the handling of solid organic wastes, but with the rapid development of house fly populations resistant to DDT and related compounds, the need for basic development of fly prevention and preclusion is again before us.

When every factor tends to favor such transmission, flies may demonstrate their proven ability to transmit the agents of some 30 different diseases, heretofore shown only under laboratory conditions (2, 5, 87).

The California, whose Bureau of Vector Control includes fly control as one of its major program elements. Its official statement (166) on "Discomfort (Nuisance) Control" is that: (in part) More and more the influence of economics and discomfort, expressed as nuisance, has become the chief basis for public support of vector control operations in this general field.

Our prosperous and ever increasing population has created, and is rapidly aggravating, enormous problems in the handling of solid organic wastes, for which there seems to be no immediate prospect of solution.

Stead (171) gave emphasis to six health aspects of refuse disposal, with flies heading the list, followed by rodents, air pollution, water pollution, transportation nuisances, and lastly changes of topography through land use for disposal.

The direct relationship of fly population level to the status of solid organic waste disposal in communities was well demonstrated by Maier & Baker in their studies of sanitation in Rio Grande Valley townes in Hidalgo County, Texas (172). By their presence and numbers, flies indicate the gravity of the disposal problem.

It is justifiable to regard flies in a community as indicator organisms, symptomatic of disposal problems and reflecting the sanitary level of the community, much as for years we have used coliform organisms as indicators of water potability.

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(2) West, L.S., The Housefly(Comstock Publishing Co., Inc., Ithaca, N.Y 584pp., 1951)
(5) Matheson, R., Medical Entomology, 2nd ed (Comstock Publishing Co., Ithaca, N.Y., 612 pp , 1950).
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(87) Mackie, T.T., Hunter, G W., and Worth, C.B., A Manual of Tropical Medicine, 2nd ed. (W.B. Saunders Co., Philadelphia, Penna., 907 pp., 1954).
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(171) Stead, F. M., California's Health, 10 153-56 (State of Calif., Dept. of Public Health, San Francisco, Calif., 1953).
(172) Maier, P.P., and Baker, W.C., Modern Sanitarian, 3, 20-23 70 (1951)

Disease/Solid Waste
Abstracts

No. DSW-76

Author

DR Lindsay, WH Stewart, & James Watt

Title

Effect of Fly Control on Diarrheal Disease
In an Area of Moderate Morbidity

Reference

Public Health Reports, Vol. 68, No. 4, 4/53

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 361 | | |

Abstract (SUMMARY)

Results of this study demonstrated that during effective fly control in an area of moderate diarrheal disease morbidity, the prevalence rate of Shigella infections and the morbidity rate from diarrheal disease were significantly lowered.

Descriptors

vectors
fly
diarrheal
disease (shigella)

Disease/Solid Waste
Abstracts

No. DSW-77

Author

G. Sacca

Title

Comparative Bionomics in the Genus Musca

Reference

Annual Review of Entomology V. 9 1964 pp. 341

Doc. No. Contract No. Date issued

Abstract

The genus, Musca, consists of about 60 species many of which are not well known. most are are distributed in the Old World.

Adult flies have exophilic or domestic habits. The endophily of the species, the said domestic , depends partly on climatic and seasonal factors. Areas in which populations of house flies can live for months without having to depend on the domestic environment, is constituted by the heaps of refuse which are thoughtlessly dumped in the neighbourhood of some towns, and in which the flies can find food both for the adult and the larval forms, as well as a temporary shelter during the mild season The production of new individuals is often huge there, owing to the abundance of larval food, made up of organic residues of vegetal and animal origin which have long fermented and are mixed with inert material (rags, waste paper, etc.) that help its aeration. In the rural areas, the flies environment is essentially constituted by stables and kitchens, and the larval development takes palce in the dung.

House flies are generally linked to the environment created by man.

Most of the other species of Musca, on the contrary, are found only incidentally inside buildings and are therefore to be considered as exophilic; their alimentary needs, however, link them to warm-blooded animals, primarily to ruminants and equids. Many species are haematophagous and some have a true blood-sucking buccal apparatus, able to pierce the skin and suck the blood or at least to remove scabs and widen wounds which are almost healed (p. 346)

During a period of 24 hr. a nourished fly can deposit from 25 to 50 fecal spots.

Flies are rather good fliers and many authors have reported their ability to travel distances of several miles.

A fertilized female is generally able to produce fertile eggs during her entire lifetime, but in order to produce mature eggs, it is absolutely necessary for her to absorbe a diet that is sufficiently rich in protein, even small quantities of proteinaceous substances are likely to be sufficient.

Descriptors

flies
disease

## Abstract (continued)

### Relation to Diseases

The medical importance of the Musca species must be regarded as of primary interest if one considers the transmission and spreading of viruses and bacteria. The Musca are seldom true intermediate hosts but generally act as mechanical carriers. They may act by three different mechanisms of transmission: (a) ingestion of the pathogenic agent and deposition of it with the foecal spots; (b) swallowing of the pathogenic agent, its temporary storage in the crop and quick deposition by vomit drops, while feeding; (c) spreading through the external surface of the body, especially legs or labella. (p. 352).

Field studies have shown that quite frequently there is a correlation between fly density and the incidence of poliomyelitis, and some cases have been recorded in which fly control had a beneficial effect on the course of an epidemic (43,44). The viruses of poliomyelitis and of Coxackie, when ingested by the flies, may remain viable in the fly's body to a maximum period of about 20 days; flies as carriers of poliomyelitis virus, have proved to be able to transmit the disease to laboratory animals.

Bacteria-It is the opinion of most authors that flies are concerned with the transmission of various pathogenic bacteria, which may be found in the bodies of flies from the field (14, 53-58).

One of the most striking evidences of this statement is the relation between house flies and diarrhoeal diseases Shigella dysenteriae (Shiga) Castellani & Chalmers has been found by many authors in the intestinal tract of the flies. Furthermore, it has been reportedly proved that the epidemics of infant summer diarrhoea are strongly influenced by the presence of a large fly population (p 353)

Protozoa-Flies can be carriers of Entamoeba histolytica Schaudinn (both cysts and trophozoites) either externally or in the alimentary tract.

Worms-A house fly may be a mechanical carrier of tape worms and nematodes. For some worms, the flies may act as true intermediate hosts.

Myasis-Althouth this occurrence is very rare, it must be recalled that larvae of Musca have been recorded as causing intestinal myasis in man.

M. sorbens is a species widely distributed in the Old World and in Australia. Owing to its special tropism toward the human body, it may be involved with the spread of a number of viral, bacterial, and parasitic diseases. Although it is not domestic, it is associated with man, on whose body it likes to rest. It is mostly attracted by sores, abscesses, or any skin lesion, as well as by eyes, nostrils, and mouth. The fly's ability to transmit tuberculosis, leprosy, yaws, eye infections, etc. has been proved. The medical importance of this species is particularly evident for the endemics of trachoma: it has been shown that fly control alone is more useful than the use of antibiotics and sulphonamides to the human population (14, 70, 71-73).

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Abstract (continued)

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Disease/Solid Waste
Abstracts

No. DSW- 78

Author

B. Greenberg and A. A. Bornstein

Title

Fly Dispersion from a Rural Mexican Slaughterhou

Reference

Amer. J. of Topical Medicine and Hygiene, V. 13

Doc. No. Contract No. Date issued

November 1964, pp. 881-6

Abstract (SUMMARY)

We have recently reported on the extensive distribution of salmonellae, among the flies of a rural Mexican slaughterhouse. The present study concerns the dispersion of these flies throughout the town and peripheral areas. A total of 543 fluorescein-tagged flies belonging to 6 species were recovered from residential sites, market place, dairy and a neighboring village, up to 3 miles from their origin. Flies spread across town within one day. The ready dispersion of Salmonella-contained houseflies, blowflies and other species constitutes a health hazard for the 100,000 inhabitants of the town and outlying communities.

Descriptors

vectors
fly
slaughterhouse

Disease/Solid Waste
Abstracts

No. DSW- 79

Author

W. C. Hueper, and W. W. Payne

Title

Carcinogenic Effects of Adsorbates of Raw and Finished Water Supplies

Reference

Amer J. of Clin Pathology. Vol 39, No.5, 5/63

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 475 | | |

Abstract (SUMMARY)

Chloroform eluates made from adsorbates of raw and finished water of a river heavily polluted with industrial chemical pollutants, when subcutaneously injected into mice, elicited the development of spindle-cell sarcomas at the site of injection. Chloroform eluates, as well as alcohol eluates of such adsorbates on activated carbon prepared from raw and finished water, when subcutaneously injected or cutaneously applied, were probably the cause of leukemic reactions in some mice. The presence of a bladder papilloma in 1 mouse injected with a chloroform eluate of raw water points to the probable contamination of the water with chemical carcinogens acting on the bladder that were released from rubber manufacturing plants. The rapidly growing contamination of sources of supplies of drinking water with carcinogenic agents demonstrates the urgent need for comprehensive chemical, experimental, and eipdemiologic investigations on water pollutants for ascertaining whether or not such exposures of the general population may represent significant environmental cancer hazards.

An indirect exposure to carcinogens in water results when vegetables and fruits grown on soil receiving carcinogenically contaminated water are used as food, inasmuch as they may take up certain carcinogenic chemicals from the soil through the roots or may retain them on the surfaces of leaves and fruits if irrigation is performed by means of the spray method. Such contaminations of foodstuffs with carcinogens contained in water are likely to accentuate cancer hazards related to the use of identical or similar carcinogenic chemicals as pesticides (arsenicals, aminotriazole, Aramite, DDT) or feed additives (7).

The great majority of carcinogenic pollutants are products of the modern, man-made, industrial economy (arsenicals released from metal ore smelters and used as pesticides and algicides; industrial effluents; chromates from chromate factories, shipyards, and airplane factories; aromatic polycyclic hydrocarbons representing wastes from coke ovens, tar distilleries, petroleum refineries, ships, motorboats, runoff from piled and tarred streets; DDT, Aramite, and

Descriptors

carcinogens
water

Abstract (continued)

aminotriazole from dusting of fields and forests; aromatic amino and nitro compounds in wastes from chemical, pharmaceutical, and rubber plants and from textile-, paper-, and plastic-dyeing establishments)....

Disease/Solid Waste
Abstracts

No. DSW-80

Author

A. Van Der Schaaf and J C. Atteveld

Title

Frequency of Salmonellae in Effluents of Modern Plants for Sewage Treatment and Possibilities for Improvement

Reference

Netherlands Soc. of Microbiology Meeting 21-11-64

Doc. No. Contract No. Date issued

(J. Microbiology & Serology, V. 31, 1965) p. 221

Abstract

Biological sewage treatment is applied on a large scale in the Netherlands. In most cases suspended and dissolved organic matter is removed satisfactorily, but from the point of view of a veterinary and medical bacteriologist the removal of pathogenic bacteria is far from complete.

This causes contamination of the water in nearly all canals, lakes, rivers, and even small brooks This water is often used as drinking water for domestic or farm animals, while waterbirds and rats swim and feed in it regularly.

Last summer in the Institute for Veterinary Bacteriology, salmonellae were isolated 7 times from diseased or dead foals Salmonella typhimurium, S panama and S. stanley were isolated from faeces or internal organs

These foals did not eat fishmeal, meatmeal or imported means of vegetable origin They only drank milk and ditch water and ate grass. Formerly S. typhimurium was the most important killer of foals. The two other salmonellae are rather new types in the Netherlands but they are already second and third in the frequency of isolates in human salmonellosis. It is obvious that these two types in foals originate from man.

In collaboration with the leader of the sewage-clearing plant in Utrecht it was possible to make repeatedly an analysis of the salmonellae in the influent and the effluent of this modern plant. Despite the fact that the total quantity of coliforms in the effluent is considerably less than in the influent, the number of cultivable salmonellae does not diminish and even appears to rise sometimes after the ordinary sewage treatment.

The number of salmonellae in the effluent fluctuates greatly. It is highest aft a dry period and especially on Monday morning.

The counts which have been made in the Utrecht effluent vary from 1-100 per ml. Although typhoid officially does not occur in Utrecht. S. typhi can be cultivated from nearly every sample of effluent. Sometimes it was possible to isolate S. typhi for the first time from samples which had been stored during one month up to 6 weeks in

Descriptors

salmonellae
sewage
contamination
pathogenic
typhoid
sludge

effluents
bacteria
water
bacteria
viruses

a refrigerator. By that time quite a number of other kinds of salmonellae had already died off and consequently no longer hindered the isolation of S. typhi.

It was shown by preliminary experiments in the laboratory that salmonellae and added N.C.D. viruses can be eliminated from the influent by adding 100 mg/liter of activated carbon powder and a 5% solution of alum up to a final concentration of 250 ppm. The flocculation and sedimentation of the sludge is to be followed by filtration of the treated sewage under a slight pressure in reversed direction through a coarse quartz sandfilter.

The quantity of sludge increased more than 100%. It contained not only the coagulated colloids and pseudo-colloids of the sewage but also a great percentage of the synthetic detergents of the influent.

The influent cleared in this way has been used repeatedly as drinking water for cattle during one week without ill effects. Goldfishes could live in it permanently without the need of mechanical aeration.

**Disease/Solid Waste**
**Abstracts**

No. DSW- 81

**Author**

S . A. Hart and P. H. McGauhey

**Title**

The Management of Wastes in the Food Producing and Food Processing Industries

**Reference**

Food Tech.

| **Doc. No.** | **Contract No.** | **Date issued** |
|---|---|---|
| V.18(4):432-8 | | Apr. 1964 |

**Abstract**

To produce and refine but a single pound of food for the American household requires that five to ten pounds of solid wastes be left in the field or processing factory.

Field and Farm Wastes--Agriculture is by far the biggest producer of wastes. The most significant of these are crop residues and animal manures (Hart and Schleusener, 1963). For example, three pounds of manure are defecated for each quart of milk produced. Livestock produce six to twenty-five pounds of manure per pound of weight gain, or a total of 1.09 billion cubic yards of manure per year--enough to supply each American family with more than 25 cubic yards. Some of this manure is left in pastures and on rangeland, and hence does not create disposal problems, but at least half of it is defecated in feedlots and barns, from whence it must be removed for disposal.

A farmer can buy and distribute bagged chemical fertilizers more cheaply than he can scrape up manure and spread it on the field (Dankenbring, 1961). He handles manure only because he must control fly breeding, odors, dust, and disease hazards to his animals. In fact, the management of manure is the number one technical problem facing the livestock industry today. Some 112 million tons of plant crops are harvested each year in the United States (Goldfield, 1962). There are three ways of disposal: plowing under, burning, or surface spreading. Plowing of wastes into the soil is expensive. In addition, nutrient imbalance of the residues often creates soil fertility problems. Burning of residues adds to the air pollution problem. Trash cutters and wood chippers are sometimes used to reduce the volume of tree prunings, corn stalks, and cotton plants. The residue is then left on the field, but this procedure may foster diseases and insects that will attack

**Descriptors**

wastes
food producing
food processing
industries
solid wastes
crop residues
manures
livestock
disposal
fertilizers
food
fly breeding
odors
dust
disease hazards
plowing under
burning
surface spreading
residues
soil fertility
air pollution
insects
fruits
vegetables
food processing wastes
cannery wastes
volume of wastes
animal feed
municipal waste
wastes management
education
research

**Abstract (continued)**

succeeding crops. Many fruits and vegetables are harvested over several weeks to several months, cull fruit from the beginning of harvest must just lie in the field and rot and create problems until the harvest is finished and disposal of the total crop residues can be undertaken.

Food-Processing Wastes--Cannery Wastes. Here, both liquid and solid wastes are produced in tremendous quantities. Most of these wastes occur in a short period, during the harvest season. In volume of wastes from a cannery, the liquid is by far the greatest, varying from one-quarter gallon to over four gallons per pound of fruit or vegetables processed.

Solid wastes--the skins, reject fruit, pits, and so forth--present truly unique problems in waste disposal. In specific cases, some solid wastes such as tomato skins and seeds may be dehydrated for animal feed. The solid wastes--the cans, bottles, packaging, food scraps, and fancy wrappings that entice the housewife--are usually managed in the haphazard manner that characterizes the disposal of food production and food processing wastes. Only, this is done by a different jurisdiction not concerned with coordinating the disposal of its wastes with that of other segments of the food waste chain.

The Conflict of Interests--the need for an integrated approach to wastes management is nowhere more evident than at the so-called "urban-rural zone of contact." Each segment of the community attacks its own waste problem with myopic concern only for itself, without regard for the impact of the whole waste problem upon society.

Possible Solutions to the Problem--Two principal approaches now seem imperative:

1. A program of education of the citizen, his elected representatives, and the food producer and processor, and
2. A program of research into economical and technologically feasible methods of community waste disposal.

No. DSW-82

Author

Title
Advanced Waste (Treatment) Research - 1

Reference
Summary Report June 1960 - Dec. 1961

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | | May 1962 |

Abstract

Contaminants of challenge (to advanced waste treatment process and damages to water quality)

Refractory Contaminants (only):

Aesthetic Effects
Tastes and odors of water and of fish from polluted waters
Foaming of detergents

Economic Effects
Corrosion, scale (Pipes, fittings)
Deterioration of ion-exchange resins
Toxicity to organisms in waste treat. systems
Adverse effect on coagulation and sedimentation rates in water treat. plants.
Inhibition of $O_2$-transfer and oxid. reactions in wast treatment systems.
Need for excessive use of soaps, detergents and softening agents.

Physiologic Effects
Lethal or other deleterious effects on acquatic life.
Overgrowth of algae or water plants.

"No adverse effects on human health attributable to the presence of refractory contaminants in this nation's tap waters have been reported. Yet trace quantities of many chem , biol. and radiol. pollutants are being detected in these waters in many areas. Although it is not known that their presence is harmful, it is also not known that their presence is safe. Toxicologist Dr. John A Zapp, Haskell Labs. DuPont . . . said: "It is a different kind of question about wholesomeness . . . what of the long run (effects)?"

Inorganic Refractory Materials
(Example given of ions present after 1 cycle of domestic water use):

$Ca^{++}$
$Mg^{++}$
$Na^{+}$
$K^{+}$

$SO_4^{=}$
$PO_4^{\equiv}$
Cl
$NO_3$

Total Alk ($CaCO_3$)
Total dissolved solids

Descriptors
**Contaminants**
**Pollutants**
**Waste**

Industrial chemicals: Cy, Ni, Cu etc.

Table 2 shows effects of concentrations of ions on physical and physiol. systems

Ca, Mg, Na, K, $NH_3$
$HCO_3^-$, Cl, $SO_4$, $NO_3$, $PO_4$
Mg - cathartic
Na - Physiol. effect on persons with heart disease etc.
K - Cathartic
$NH_3$ - Toxic to fish
$SO_4$ - Cathartic
$NO_3$ - Stimulates undesirable aquatic growth - Methemoglobmenia in infants
$PO_4$ - Stim. undesirable aquatic growth.

Organic Refractory Materials

Primary treatment of sewage removes only 30-40% of BOD materials (settling).
Secondary treatment of sewage removes 80-90%.
Ether extractables, proteins, carbohydrates, polysaccharides, tanning, lignins, alkylbenzenesulfinate (detergent) unidentified - and organic acids.

Disease/Solid Waste
Abstracts

No. DSW-83

Author

C. Burns

Title

Infectious Hepatitis: - Its Incidence in

in Leister and General Epidemiology

Reference

Royal Society of Health Journal 85:144-8

Doc. No. Contract No. Date issued

May-June 1965

Abstract

Season variation, age and sex incidence, spread (mode, etc.), clinical features and prognosis are discussed. Mode of spread: The epidemic indications point to transmission by contact (oral or nasal?). However "while the disease has frequently been transmitted by feeding fecal suspensions to volunteers, virus has not been detected in material from the naso-pharynx." [5] Large numbers of anicteric or subicteric clinical cases occur which are not diagnosed but are infectious. Also patients are infectious during the incubation period (i.e., about 20 days before onset of jundice). The incubation period itself is long and variable - up to 6-7 weeks. Some patients continue to excrete virus for long periods after clinical recovery (up to 15 months noted in 1 report [5]).

Descriptors

Disease/Solid Waste
Abstracts

No. DSW-84

Author
H. I. Magy

Title
Part I: An Evaluation of the Organic Wastes
Associated with Fly Production in Orange County

Reference
Calif. Dept. P. H. Bureau of Vector Control

Doc. No. Contract No. Date issued

Abstract

The prevalence of domestic flies in a community indicates the complete management of residential, commercial, industrial or agricultural solid organic wastes. Under favorable weather conditions, domestic flies are produced unless wastes are dehydrated, removed or otherwise treated. 13 flies of public health importance are discussed as to season and waste preference (p.2). Dispersion up to 20 miles from source was noted. Present and projected inventory of solid organic wastes and fly production are discussed.

Solid Wastes

A. Crop Wastes

- cuttings ) remain in field or
- cull vegetables) are stockpiled, fed to animals, etc.
- Processed vegetable and fruit wastes: returned to fields, fed to cattle stored temporarily in transfer trucks or dumped at disposal sites.

Crops in Orange Co.: Citrus, avocado, other fruits, nuts grapes and berries peaches, tomatoes, peppers, melons, vegetable crops, (celery, cauliflower, spinach, potatoes, sugar beets, yams), field crops, nursery and cut flowers.

B. Livestock Wastes

- chicken manure (horse manure apparently of no consequence in this area.)
- cow manure

C. Community Organic Wastes

1. Industrial organic wastes
   Food processing wastes
   Fertilizer plant wastes

Descriptors

Commercial organic wastes
Crop wastes
Dead animals
Fertilizer
Leaf and litter debris
Livestock wastes
Manure
Sludge
Solid waste

2. Residential refuse (homes, apts, hotels)
3. Commercial food handling estab. wastes (restaurants, school cafeterias, meat markets, produce markets, supermarkets)
4. Leaf and litter debris (streets, alleys, vacant lots)
    a. Dead animals
5. Solid wastes recoverable from sewage treatment plants (sludge)
6. Domestic animal manure (dog, cat, horse, poultry, etc.)

Estimated that 3.5 lb/cap./day of organic and inorganic refuse is collected daily in Orange Co. from community waste sources. 10% wt. is garbage and 50-60% is combustible.

Of processed fruits and vegetables wastes mentioned, only 1% of processed citrus, 10% of cauliflower, 1% of potatoes, 20% of tomatoes and 6% of yams go to disposal sites. The remainder is returned to the field, converted to annualfeed or sold for futher processing. (No mention of the ultimate fate of residues from this last diversion is mentioned).

Municipal refuse - 1800 tons daily dumped at disposal sites. 1,000,000 inhabitants represented. Use of garbage grinders in homes disposes of 70 tons/day but does not eliminate fly production in garbage cans.

Sludge - 65 tons/day. Some sold to commercial fertilizer plants. Some deposited on agricultural land as fertilizer. With overload of treatment plants or other malefaction, fly production results from premature drying in beds.

Domestic animals - not subject to accurate inventory.

Miscellaneous backyard sources - Compost piles, etc. become a haven for fly breeding. Fallen fruit causes production of several kinds of flies. Dog and cat droppings produce several species. Spilled garbage can produce most of the flies listed.

Total organic wastes - 570,000 tons - Truck crops 53K, process fruit 15.4K, poultry manure 42K. Dairy manure 107K, rabbit manure 65T, dead livestock 710T, raw sewage sludge 24K, res. and comm. 328K.

**Disease/Solid Waste**
**Abstracts**

**No. DSW-** 85

**Author**

R. W. Armstrong

**Title**

Environmental Factors involved in Studying the Relationship Between Soil Elements and Disease

**Reference**

Amer. J. of Pub. Health, Vol. 54, No. 9,

| **Doc. No.** | **Contract No.** | **Date issued** |
|---|---|---|
| pp. 1536 | 1964 | |

**Abstract**

Studies of the soil-disease relationship have in common a general hypothesis which could be stated as follows: That excesses or deficiencies of trace elements or organic compounds in certain soils, which are transferred to man through water, vegetables, grains, and fruits, or, via pasture-grazing animals in the form of meat and milk, increase the susceptibility or resistance of the body to disease.

The relationship between iodine and goiter is the only convincing link between the composition of the soil and human disease so far established, and even this link is not so direct as was first believed....

Analyses of zinc, cobalt, and chromium from 104 garden soils, where a stomach cancer death had occurred after ten or more years of residence, had levels higher than those for controls with a statistical significance of over twice the standard error of the difference.

Healy and others,...in attempting to explain a marked difference in the rates of dental caries among children in two adjacent towns in New Zealand, found from analyses of soils, water, and vegetables that higher contents of molybdenum, aluminum, and titanium, and lower contents of barium, copper, manganese, and strontium were associated with a lower incidence of caries.

Between the point at which soil, or plants, or drinking water are sampled and the point of food consumption deriving from them, several physical and cultural factors may intervent to alter the trace element composition. Because of these factors it is unlikely that analyses of soil, plants, and water, by themselves, could provide a reliable indication of the trace element content of the ultimate human foodstuffs. The nature and extent of these influencing factors will depend on local conditions but they can be considered under six general groups:

(1) Factors affecting the trace element composition of soils, such as

**Descriptors**

environmental factors
relationship
soil
disease
mineral micronutrients
trace elements
plants
animal husbandry
livestock
animal health
human health and disease
foodstuffs
soil disease relationship
water
vegetables
grains
fruits
meat
milk
iodine
goiter
cancer
dental caries
zinc
cobalt
chromium
molybdenum
aluminum
titanium
barium
copper
manganese
strontium
fertilizer
metabolism
insecticide
feeding program
metal contacts
preservative agents
cooking
pumping
chemical treatment
personal habits

Abstract (continued)

fertilizer applications, cultivation, and draining.

(2) Factors governing the trace element composition of plants, such as the metabolism of the plant, its genetic variety, age at harvest, amount of light and radiation received, soil and air temperatures, rainfall, humidity, windflow, and insecticide applications....

(3) Circumstances operating on pasture-grazing animals that may alter the trace element composition of trace elements in their end food products of milk and meat, such as feeding programs, animal metabolism, and milk lactation.

(4) Alterations of the trace element content of foods through processing, such as in the smoking and salting of meat, grain milling, metal contacts, addition of preservative agents, cooking, etc.

(5) Factors involved in the handling of water supplies, as in metal contact through pumping, piping, and storage, and chemical treatment for purification.

(6) Personal habits of the subjects themselves, such as the amount of food and water consumed, food preferences, and eating habits in general.

A representation of the movement of trace elements from the soil to man on Icelandic farms is given in Figure 1. This can be envisaged as part of a mineral cycle whereby trace elements move from the soil through plants and animals to man, to eventually return to the soil through waste products and death.

...Trace elements in plant materials follow a complex path subject to modification by the natural environment, agriculture, animal metabolism, and the cultural processes of food preservation and cooking.

...In effect, the dairy herds graze entirely on fodder grown on the home farm soil and drink farm water, so that their milk acts as a direct transmitting agent for the trace elements from the soil of their respective farms to the inhabitants of those farms.

The meat of lambs on the other hand, is only an indirect reflection of the trace element composition of the home farm soil, for nourishment which the animal receives from this source comes only through gestation and the ewes' milk.

Animal metabolism will further modify the trace element content of the meat away from that obtaining in the farm pasture and will also distribute the elements quite selectively in different body tissues and organs.

Salting and smoking are, therefore, the more common methods and both introduce additional chemical elements and compounds into the meat.

The trace element content of meat, and of the vegetable portion of the diet - mainly potatoes, is further affected by cooking processes. Most influential will be metal contacts in storage containers and cooking utensils, the amounts of water and salt used, and the rejection of certain portions of the meta and vegetables through cutting and paring. All components of the diet, including drinking water, will be affected by personal factors such as quantities consumed, preferences for certain foods, and eating habits. Personal factors may, in themselves, determine more than anything else the amounts and proportions of trace elements ultimately taken into the body.

Abstract (continued)

Spectographic analyses of 23 primary and trace elements in the plant and water samples collected from the stomach cancer and control farms in Iceland failed to reveal any significant differences between the two groups.

...It must be emphasized that there are several possible connections between soil and disease other than trace elements which might be investigated. For example, organic compounds, radionuclides, or pathogenic organisms can each exist in wide variety and intensity in different soils and could conceivably form an association between soil and human disease. Where geographical associations between soil and disease appear to exist they should be pointed out with caution, mindful that other factors unrelated to the soil but associated with it may form the true association with the disease, or, if the soil is involved, that the relationship is not likely to be a simple one.

Descriptors (continued)

cows
water
smoking
aluminum
organic compounds
dairy herds
lambs
boron
iron
radionuclides
fodder
salting
copper
sodium
pathogenic organisms

Abstract (continued)

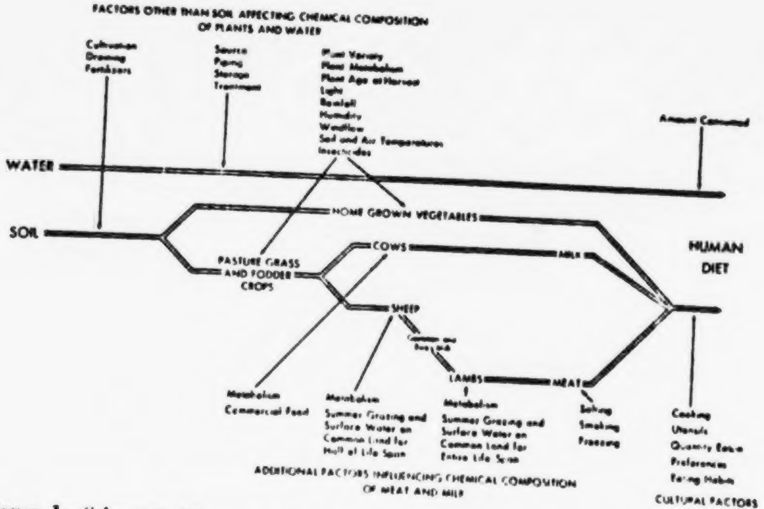
FACTORS OTHER THAN SOIL AFFECTING CHEMICAL COMPOSITION OF PLANTS AND WATER
Cultivation
Drainage
Fertilizers
Source
Piping
Storage
Treatment
Plant Variety
Plant Metabolism
Plant Age at Harvest
Light
Rainfall
Humidity
Windflow
Soil and Air Temperatures
Insecticides
Amount Consumed
WATER
SOIL
HOME GROWN VEGETABLES
PASTURE GRASS AND FODDER CROPS
COWS
MILK
SHEEP
LAMBS
MEAT
HUMAN DIET
Metabolism
Commercial Feed
Metabolism
Summer Grazing and Surface Water on Common Land for Half of Life Span
Metabolism
Summer Grazing and Surface Water on Common Land for Entire Life Span
Salting
Smoking
Freezing
Cooking
Utensils
Quantity Eaten
Preferences
Eating Habits
ADDITIONAL FACTORS INFLUENCING CHEMICAL COMPOSITION OF MEAT AND MILK
CULTURAL FACTORS

**Figure 1**—Schematic Diagram of the Transport of Trace Elements from the Soil to the Diet on Icelandic Farms and the Possible Factors Influencing Composition En Route

Disease/Solid Waste
Abstracts

No. DSW-86

Author
C. L. Metcalf, W. P. Flint (revised by
R. L. Metcalf)

Title
Destructive and Useful Insects - Their Habits
and Control

Reference
4th Edition, McGraw-Hill, 1962

Doc. No.
Contract No.
Date issued

Abstract

R. L. Metcalf is Professor of Entomology at University of California at Riverside.

(Note: A search for the descriptor "waste" or its synonyms in the index turned up a simple reference, "trash" - p. 410. However "food-infesting insects", pp 37-9, was considered applicable because such insects could be considered as possibly infesting garbage. Similarly, any plant residues may be suspect if the original plant harbors an insect. Animal wastes also are suspect. Whether or not organic wastes are important to the maintenance or spread of insect life will depend on the individual organism's mode of existence.)

This book discusses the enormous economic losses incurred by man through the world of insects. Of the 21 chapters, 14 deal with insects injurious to man, his foods or to his domestic animals. (Just how important waste is to insect survival and spread is not discussed. E.g., while the European corn borer is so destructive that a cleanup of all corn refuse is made compulsory in some areas, it and others can survive by preying on weeds appearing earlier and later in the season.) During the winter "many crop insects hide under surface trash such as boards, boxes, sacks, brush heaps, stone piles, dense grass, fallen leaves and other dead vegetation." (p. 410). Stored grain pests can maintain themselves in waste grains and screenings and spread to stored food grains (p. 933)" . . . frequent infestations are sure to occur from the waste grain about the (storage) buildings . . ." Such insects as the pea weavil winter in the seeds left in the field. Bean vines and other bean plant refuse help sustain the bean weevil (p. 938). Methods for controlling stored grain insects emphasize the removal (from food grain storage areas) of all refuse grain, seeds, grain products, flour meal or other material in which insects breed (p. 932). Plant wastes harbor the pests in various stages of development.

The interesting comment (p. 832) is that ". . .The caterpillars (of the brown-tail moth) also cause great annoyance and sometimes serious illness to human beings

Descriptors

Animal wastes
Anthrox
Disease
Domestic animals
Economic losses
Foods
Garbage
Insects
Loa loa
Manure
Organic wastes
Pathogens
Trash
Tularemia

Abstract (continued)

because their hairy bodies are equipped with nettling hairs which on entering the skin cause a rash that is very irritating. There have been some instances where the insect probably caused death from large numbers of the hairs being breathed into the lungs." (No reference is given to the source of this statement.) The insect is stated to be a very important pest of deciduous shade and fruit trees.

Citrus insects. Such insects as fruit flies deposit their eggs in the fruit rind. As a control measure, "in infested areas fallen fruit should be collected daily and buried to a depth of several feet or burned or cooked to destroy the larvae." (p. 814) The larvae spend 6-25 days in the fruit. The citrus rust mites deposit eggs in depressions on the fruit and leaves. After 2-8 days the nymphs hatch. The citrus whitefly deposits its eggs on the leaves. These hatch in 4-12 days and the nymphs feed on the leaves. Citrus meelybugs hatch from eggs in 6-20 days and attack leaves and fruit. Thrips and citrus scales are also discussed.

Note: Nowhere is any statement made with regard to the relative importance of waste supported infectations as compared with those in the growing plant and its products.

In addition to their own destructiveness, plant insects are vectors of plant pathogens of all kinds. Due to their enormous reproductive capacity, even small numbers finding harbor in waste can infect entire crops in the following season.

"The adult grape leafhopper, like many of the other grape insects, pass the winter in shelter afforded by trash, weeds or grasses . . . . ."

Other fruit flies hatch from waste fruit: "Cull cherries around canneries and picking stands should be destroyed immediately by heat or buried deeply" (p. 770). General orchard sanitation is advised for the control of the plum curculio in plum, apple and peach orchards. Burning or deep burial of dropped fruit is recommended. To control the peach bark beetle it is advised that "all peach prunings and dying or diseased trees in or around the orchard . . be removed and burned during the winter" (p. 756).

Note: In spite of the varying life cycles etc. of plant insects, the different kinds that prey on the same plant and the ability of plant waste to provide food and give harbor to destructive insects has significance for plant waste control. Plants such as weeds also provide harbor or food and their proper disposal is implied.

Tomato fruit worm - (p. 658) - For control, infested fruit must be burned or buried.

"Horse flies are the known carriers of Loa loa, tularemia and anthrox which they may spread by biting a person or animal soon after feeding on a diseased animal or carcass" (p. 1008). "The most injurious insect attacking horses and mules is (the stable fly). . . . As a result of the pain from the bites, the constant worry and the loss of blood, animals lose weight, milk yield of dairy cattle is reduced . . . and sometimes animals are killed, either as the direct result of the flies or from disease induced by the flies. While the stable fly has been suspected of transmitting infantile paralysis, anthrox, leprosy, surra and swamp fever, it has not been proved to be the usual carrier of any animal disease in

Abstract (continued)

America" (p. 94203). It attacks "horses, mules, cattle, hogs, dogs, cats, sheep, goats, guinea pigs, rabbits, rats and man. They breed in "wet straw piles or strawy manure . . . and have been found developed in great numbers on the trickling filters of sewage disposal plants." (p. 943). They breed in plant wastes and stock food especially when contaminated with manure (p. 943-4). Horn flies (p. 954 ff) breed only in fresh cattle dropping. They are a source of economic loss in cattle breeding and dairying. Face fly larvae breed in cow dung and other excrement (p. 956).

House fly (p. 1031 ff) - Comprise 98% of all flies found in dwellings . . . "naturally infected with the pathogens of more than 20 human diseases, and many authorities believe that the fly is an important vector of typhoid fever, epidemic or summer diarrhea, amebic and bacillary dysentery, cholera, poliomyelitis and various parasitic worms. However adequate epidemic* evidence is available only for bacillary dysentery . . ." (USPH Reports 63:1319 - 1334, 1948). House flies also serve as intermediate hosts of roundworms (horses) and tapeworms (chickens). They carry disease germs externally or internally . . ." Most house flies come from animal manure. "The larvae are believed to feed upon microorganisms which cause fermentation and decay thence live only in moist masses which are warm enough to promote the growth of these organisms. . ." While horse manure is preferred they can develop in any moist, warm, fermenting organic matter - piles of grass, decaying fruits or vegetables, garbage, and waste about feed troughs, human and animal excrement of all kinds.

"The presence of house flies is an indication of our failure to dispose properly of manure, garbage, sewage, food wastes, human excrement, dead animals or other organic waste". "A 1/2 ton manure pile, after being exposed for only 4 days, was found to contain an estimated 400,000 larvae, or 400 flies per pound."

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* Epidemiologic evidence.

**Disease/Solid Waste Abstracts**

No. DSW- 87

**Author**

Jeannette Donker-Voet

**Title**

My View on the Epidemiology of Listeria Infections

**Reference** M.L.Gray-2nd Symp. on Listeric Infection, Vet. Res. Lab; Montana St. Coll.

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pp. 137 | | 1963 |

**Abstract**

Much is still obscure regarding the epidemiology of listeriosis. The disease is world-wide and affects a wide variety of species, yet no evidence has been produced that there is a natural reservoir of infection and the original source of infection amongst man and animals most often remains a myster.

It is my opinion that the carrier animal is the principal reservoir of the infection. The sera of many cows, horses and dogs agglutinate suspensions of L. monocytogenes. Although there is no proof that these agglutinations are specific, they give the impression that subclinical infections are common. Dissemination of Listeria from the uterus, milk, foci in the liver via the bile, and the feces of a carrier animal, can represent a danger to neighboring animals. As Listeria has remarkable powers of remaining alive outside the animal body, the soil may become contaminated over a long period of time. Not only domestic animals, but also wild animals, especially rodents and birds, may be vectors and contaminate the soil.

The cow Dora is a carrier of Listeria monocytogenes which she has shed with the milk of all four quarters for a period of at least 7 months. Her milk appears completely normal although there is a mastitis. Under farm conditions she may have spread histeriosis with the milk, peat-dust and straw.

**Descriptors**

epidemiology
listeriosis
disease
natural reservoir
Listeria monocytogenes
uterus
milk
foci
liver
bile
feces
soil
domestic animals
wild animals
rodents
birds
vectors

peat-dust
straw
waste

**Disease/Solid Waste**
**Abstracts**

**No.** DSW-88

**Author**

Alexander D. Langmuir

**Title**

The Surveillance of Communicable Diseases

of National Importance

**Reference**

New Eng. J. of Med., Jan. 24, 1963

| **Doc. No.** | **Contract No.** | **Date issued** |
|---|---|---|
| pp. 182 | | |

**Abstract**

When epidemiologic studies were initiated in 1947 quite surprising findings were revealed. Simple appraisals of the morbidity and mortality reports indicated that these traditional measures were grossly erroneous. The highest reported incidence occurred in Mississippi, South Carolina and Texas, but these three states followed the practice of requesting weekly reports of malaria by numbers of cases seen rather than by name of individual patient. Such a system encourages exaggeration. Efforts to substantiate the diagnoses by laboratory study consistently failed. Beginning in 1947, Mississippi changed its reporting requirements. The incidence dropped from 17,764 cases to only 914 in the first year, and appraisals among even these cases revealed that only a very few could be verified.

...New criteria soon revealed that malaria had disappeared as an endemic disease from the South, probably before the DDT program had gotten underway....

...At sometime between 1935 and 1945 malaria mysteriously disappeared ... The slight rise in the morbidity curve in 1945 reflects the influx of infected veterans....

The sharp peak in the curve in 1951 and 1952 reflects the Korean War and the occurrence of several thousand cases among veterans who returned before the primaquine treatment for all returning servicemen was instituted.

In the past five years the incidence of reported malaria in the whole country has remained below 100 cases a year.

Beginning in 1950, the Communicable Disease Center took an active part in epidemiologic field investigations of hepatitis. Many outbreaks spread by contact, and a few waterborne epidemics were described. ...No systematic surveillance was undertaken until 1960.

The importance of raw shellfish, both oysters and clams, as an occasional

**Descriptors**

communicable diseases
epidemiologic studies
veterans
Malaria Surveillance Program
Communicable Disease Center
contact
oysters
salmonella infections

surveillance
endemic disease
incidence
waterborne epidemics
clams
decision makers

Malaria
morbidity
Poliomyelitis
Influenza
Hepatitis
shellfish
health problems
epidemiologist

Abstract (continued)

factor in the spread of infectious hepatitus was established for the first time in this country.

...Raw clams could be incriminated, but the tracing of the sources of these contaminated clams proved more difficult. Slowly, the evidence focused on Raritan Bay. On May 1 this area vas officially closed to the further taking of raw shellfish.

Exploratory studies are now well underway for surveillance of salmonella infections, at least with a selected group of volunteering states and other interested agencies.

...Many communicable diseases of national importance continue to exist. Although somewhat out of fashion, they are clearly unfinished business.

When major health problems arise, someone must make decisions. This is not the primary responsibility of the epidemiologist. Administrative and political as well as technical considerations must also be brought to bear. It is the epidemiologists' function to get the facts to the decision makers.

Good surveillance does not necessarily ensure the making of the right decisions, but it reduces the chances of wrong ones.

**Disease/Solid Waste Abstracts**

**No.** DSW-89

**Author**

E. Richard Harrell

**Title**

The Known and the Unknown of the Occupational Mycoses

**Reference**

Ind. Medicine & Surgery, May 1964

| **Doc. No.** | **Contract No.** | **Date issued** |
|---|---|---|
| pp. 306 | | |

**Abstract**

...Causes of possible occupational disease:

| Disease | Etiologic Agent |
|---|---|
| Histoplasmosis | Histoplasma capsulatum |
| North American blastomycosis | Blastomyces dermatitidus |
| Coccidioidomycosis | Coccidioides immitis |
| Cryptococcosis | Cryptococcus neoformans |
| Sporotxichosis | Sporotrichum schenkii |
| Candidiasis | Candida albicans |

...One should ... expect to find histoplasmosis acquired by pulmonary inhalation in those individuals who might have the best opportunity for contact with soil contaminated by these sources. Farmers are ideal candidates for pulmonary histoplasmosis; and, indeed, if one were to set about deliberately acquiring this disease, the best opportunity might come from the cleaning of an old abandoned chicken house. Minor epidemics of histoplasmosis have also occurred in laborers handling such soil specimens....

Coccidiodomycosis can be considered as occupational to some extent in those whose work takes them into the desert areas of the Lower Sonoran Life Zone, and most especially in the San Joaquin Valley.

Sporotrichosis is almost invariably acquired by the cutaneous inoculation of

**Descriptors**

mycoses
Coccidioidomycosis
Candidiasis
starling
occupational hazard
Histoplasmosis
Cryptococcosis
soil
feces
pigeon
Blastomycosis
Sporotrichosis
chicken manure
bats

Abstract (continued)

the organism at the time of some form of trauma to the skin. Agricultural workers and florists also have been documented as having increased occupational hazard, for this disease has been acquired from a puncture of the skin by a rose thorn or by thorny shrubs or bushes

Disease/Solid Waste
Abstracts

No. DSW-90

Author

L. S. West

Title

The Housefly

Reference

Comstock Publ. Company, Ithaca, N. Y. 1951

Doc. No. Contract No. Date issued

Abstract

Chapter XI. p 264 "Flies and Human Disease"
p. 266 - "There is a present time acceptable laboratory proof for the transmission of approximately 30 diseases (or parasitic organisms) by M. Domestica and related forms." Typhoid, paraty, cholera, bacillary dysentery, infantile diarrhea, anthrox, conjuncitivits, tuberculosis, leprosy, plague are listed as bacterial diseases with the implication (but no factual data of an epidemiol nature) that they are transmitted to human beings successfully by flies. Similarly, without epid. wid. viral disease, and trachoma, polio, spirochetes, yaws; protozoan disease, amebic dysentery and giardiasis are implicated.

(p. 272) Evidence for Disease Transmitted by Flies. "Flies are rarely the sole transmitting agency . . . Any epidemic, and in most cases their role, however important, must logically be considered subordinate." Most of the discussion is with regard to the ability of flies to transmit disease organisms and there is essentially no epidemiol. evidence presented or referred to.

Descriptors

Flies
Disease
Typhoid
Paraty
Cholera
Bacillary dysentery
Infantiel diarrhea
Anthrox
Conjunctivitis
Tuberculosis
Leprosy
plague
Viral disease
Trachoma
Poliomyelitis
Spirochetes
Yaws
Protozoan disease
Amebic dysentery
Giardiasis

Disease/Solid Waste
Abstracts

No. DSW-91

Author
P. H. McGauhey, Asst. Dir. Sanitary Engrg.
Research Project, U. of California

Title

New Methods of Refuse Disposal

Reference

The Sanitarian 15:59-64 (Sept-Oct) 1952

Doc. No. Contract No. Date issued

Abstract

Present methods. Disposal into water; disposal on land; incineration; rendering of garbage; and the feeding of garbage to hogs.

Disposal into water has almost disappeared from American practice. Dumping refuse on the ground some distance from human habitation, however, is still practiced in a number of smaller communities but most of them are already faced with the urgent need for better disposal.

"Sanitary land fill" is without doubt the most economical of all methods currently used for refuse disposal. At its best it is a clean, satisfactory and sanitary procedure which in many instances leads to the reclamation of low lying areas for useful park or building sites. At worst it is a dismal undertaking conducive to the breeding of rodents, flies, and other vectors of disease; polluting the air with odors, smoke, and gases from the inevitable smouldering fires set intentionally or by vandals.

The principal limitations of the sanitary land fill method are the lack of suitable areas for making such a fill within any conceivable economic haul distance from the city, and the wastage of valuable organic matter inherent in the method. The lack of land fill areas is a very real one in many cities.

Incineration. It is impossible to ignore the increasing importance of air pollution. Like the land fill operation, incineration destroys useful organic matter.

Neither of the other practices - rendering of garbage, and feeding of garbage to hogs - represents an answer to the refuse disposal problem of cities.

Health officials are becoming increasingly dissatisfied with the public health aspects of the use of raw garbage in hog feeding, and cooking of garbage does not appear to the feeder to be a profitable alternative.

Descriptors

Refuse disposal
Dumping
Sanitary land fill
Rodents
Vectors
Incineration
Organic matter
garbage
Composting

Two new methods, both involving conservation of organic matter for use on the soil, are currently in early stages of development as practical answers to some of the refuse disposal problems of American cities. One envisions the grinding of garbage into the sewer, either in the individual household or at municipal grinding stations strategically located throughout the city, whence it is digested and recovered along with sewage sludge. The other proposes to reduce the combined organic refuse of the community by a process known as composting, to yield a humus which can be used either as a soil conditioner, or be reinforced to make both a fertilizer and a soil conditioning material.

Disease/Solid Waste
Abstracts

No. DSW-92

Author

Salvatore Corbo

Title

M. Domestica Chiefly Responsible for Infant
Mortality due to Gastrointestinal Disease
(7 Years Observation)

Reference

Rivista Di Parassitologia

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Vol. 14: 55-59, Jan. 1953 | | 1953 |

Abstract

Summary

The author has followed for 7 years the trend of infantile mortality, due to gastrointestinal diseases in the province of Latina, where large areas were treated with DDT, Chlordane, Metoxiclor and Dieldrin. He has observed that the mortality curve drops considerably when houseflies are eliminated.

When, however, these insects, because of their resistance to insecticides, were not destroyed, the infantile mortality due to gastro-intestinal diseases was not reduced.

The author calls the attention of pediatricians and sociologists on the importance which is acquiring the housefly control.

Descriptors

Flies
Gastro-intestinal disease
Vectors

Disease/Solid Waste
Abstracts

No. DSW-93

Author
C. W. Stiles et al.

Title
Experimental Bacteria and Chemical Pollution of
Wells, via Ground Water, and the Factors Involved

Reference
U.S. P.H.S. Bulletin 147:1-136 1927
Doc. No. Contract No. Date issued

Abstract

Bacteria pollution (B. coli) recovered from ground (well) water in 1213 samples, taken under most rigid techniques, at distances of 1-232 ft from the experimental trench into which uranin + excreta pollution was placed. Chemical pollution (uranin) was recovered up to 450 ft from the trench; both uranin and B. coli traveled in only 1 direction; that of ground water flow. Wet weather (high ground water) is conducive to extension of pollution; dry weather inhibitive. B. coli tends to localize in the upper blanket at or near ground water table. If the soil remains dry sufficiently long, B. Coli dies; in experimental infection of ground water B. Coli remained alive 32 months; uranin remained visible 31 months. As pollution travels it does not appear to expand laterally with the trench as the apex of a truncate cone, but contracts to a narrower breadth. If the direction of the ground water is unknown, distance represents the great factor of safety.

Descriptors

Ground water
Pollution

Disease/Solid Waste
Abstracts

No. DSW-94

Author

H. Tsuchiya, H. etc.

Title
The Incidence of Intestinal Protozoa among Freshmen Med. & Dental Students with Special Ref. to Amebiasis

Reference

American Journal Trop-Med, 20(6): 803-8 (1940)

| Doc. No. | Contract No. | Date Issued |
|---|---|---|
| | | |

Abstract

In 562 students examinations in 6 years, incidence of 2-5% in students ( and hospital attendants) indicated incidence approximately that of N.O. and Philadelphia. Those harboring E. Histolytica gave no history of diarrhea or symptoms suggestive of clinical amebiasis (with one possible exception).

Descriptors

Amebiasis
E. histolytica
Protozoa

Disease/Solid Waste
Abstracts

No. DSW-95

Author
Schüffner, W.

Title
Leptespirosis bie zahmen Ratten und der Schutz gegen die Ansteckung gefahr

Reference
Zeitscher, Immunitätsforsch, 99(4): 323-32 (1941)

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | | |

Abstract

Following a Weil infection in an attendant, 40% of the white rats of a commercial house were found to be infected with Leptospira. Personnel were vaccinated with heat-inactivated cultures IV or SC. On second injection titres rose to 1:300 to 1:4000.

Descriptors

Leptespirosis
Rats

Disease/Solid Waste
Abstracts

No. DSW-96

Author
Hino, I. and Kakugoro, N.

Title
Microbiological Changes in the Soil of Continuou
Pea Culture and the Possible Causes of "Iyati"
(Sick Soil) of the Field (Japanese with
English Summary)

Reference
Journal Science Agriculture Soc. (Japan)

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 287:430-37 | | 1927 |

Abstract

Results of the author's experiments, 1923-26, on continuous cultivation of peas in the same fields are as follows: Culture experiments provide that the yield is directly proportional to the bacterial content of the soil. Also the number of soil bacteria is negatively correlated with that of soil protozoa especially the ciliates, due to the fact that the latter considerably diminish the numbers of soil bacteria. The cause of soil sickness in continuous pea cultivation in the same field is chiefly due to the diminished bacterial activity caused by these protozoa. Amebas are not so effective in this respect as cilidtes. Further, the abundance of soil fungi conduces to soil sickness and inhibits germination of seed, but this effect is only temporary. Continuous pea cultivation acidifies the soil reaction, but in itself has no effect on bacterial content of the soil and consequently on the crop yield.

Descriptors

Bacteria
Fungi
Protozoa

No. DSW-97

Author

P. W. Kabler, USPHS, Cincinnati, Ohio

Title

Bacteria Can Be a Nuisance

Reference

Chem. Eng. Progress 59:23-25 (Nov 1963)

Doc. No. Contract No. Date issued

Abstract

The author says that bacteria customarily used as indicators of water quality (e.g. coliforms) represent only a small fraction of the total bacterial contribution of waste waters and that, using present methods, some members of all these populations will still be present in the treatment effluents ready to grow under favorable conditions. Diseases of humans and animals, offensive tastes, slime growths - these are possible results of failure to remove all bacterial life.

The author believes that biological systems of waste treatment are promising and can produce effluents with organic residues in much lower concentration than are now normally observed. Even some inorganic materials can be broken down to less harmful compounds or elements. Selective biological methods may combat special problems.

Problems of residue-disposal are mentioned.

Descriptors

Bacteria
Diseases
Inorganic materials
Residue-disposal
Waste treatment

**Disease/Solid Waste Abstracts**

No. DSW- 98

**Author**

**Title**

Isolations of Enteric Viruses from Sewage and River Water in a Metropolitan Area

**Reference**

Am. J. Hygiene 80:320-27 1964

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| | | |

**Abstract**

Summary: 164 weekly samples of sewage and river water collected July-Nov 1962 were tested for presence of enteric viruses. 81 (49%) were found to contain virus. Raw sewage yielded the highest frequency of plus samples (80%). 52% of the effluent samples were plus. About 1/4 of the river water samples contained viurs. Group B coxsackie and polioviruses were most common; Group A coxsackie viurses were less common. Type 7 Echovirus was found in 16 samples and Type 1 reovirus in 18.

Specimens collected in July and August yielded the largest number of viruses.

**Descriptors**

Enteric viruses
Coxsackie
Polioviruses
Echo viruses
Reovirus
Sewage
Viruses
Water

**Disease/Solid Waste**
**Abstracts**

No. DSW-99

**Author**
N. W. Levine

**Title**
Protozoan Parasites of Domestic Animals
and of Man

**Reference**
Burgess Publ. Company, Minneapolis, Minn.

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| | | 1961 |

**Abstract**

Contains chapters on Introduction to Parasitology and to the Protozoa. Other chapters cover the hemoflagellates, histoma, trichomonads, other flagellates. The Amoebae, the Telesporasida and the Coccidia proper, Klossiella and Hepatozoon, Plasmodium, Haemoproteus and Leucocytozoon, the Piroplasmasida, Sarcocystis, Toxoplasma and related Protozoa. The ciliates and laboratory diagnosis of Protozoan Infectious. The appendix has scientific common names of some domestic and wild animals.

An organism which harbors a parasite is a Host. A definitive host is that which harbors the adult stage; an intermediate host harbors the larval stages; a first intermediate host is the first host parasitized by the larval stages; a second intermediate host is the host parasitized by the larval stages at a later period on the life cycle. A paratenic or transport is a second or third intermediate host in which the parasite does not undergo any development but usually remains encysted until the host is eaten by the definitive host.

The vector of a parasite or disease agent is an arthropod, mollusc or other agent which transports the parasite from one vertebrate host to another. If the parasite develops or multiplies in the vector, it is called a biological vector. If not, the vector is a mechanical one.

Natural host - Expression of the actual parasite/host relation in a particular time and place.

Potential host - Potential refers to the absolute infectability of potential hosts and not to the natural situation. "The complete host spectrum has not been worked out for any parasiet. . . However, it will have to be done. . . before we can under-

**Descriptors**

Biological
Epidemiology
Host
Parasites
Protozoa
Vector
Zoonosis

**Disease/Solid Waste Abstracts**

**No.** DSW- 100

**Author**

**Title**

Microepidemics of Fungus Diseases

**Reference**

Arch. Environ. Health - Vol 12, Jan 1966

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pp. 1 | | |

**Abstract**

...Although 60% of the cases of sporotrichosis have occurred in the Mississippi Valley (2) microepidemics of this fungus infection can occur throughout the country. ...Cases associated with sphagnum moss have been reported from Florida and from Michigan among tree handlers. Additional cases among foresters who handle sphagnum have been reported in the Mississippi basin area. Sphagnum moss apparently served as the vehicle for transmission of the disease. ...This sphagnum moss is shipped throughout the country and casual cases have been reported in various areas....

...There is considerable opinion among epidemiologists that this disease... (histoplasmosis)...is spread largely by small localized epidemics. This is in conformity with the theory that histoplasmosis is spread from localized microfoci of growth of the organism and is contracted in humans by visits to these microfoci. Spores growing in the soil are stirred up and subsequently inhaled.

This occurrence of farmer's lung among farmers exposed to heavy growth of Aspergillus species in silos and other storage bins is well known. Here again the local microclimate appears to be the deciding factor in the localized propagation of the fungus.

**Descriptors**

sporotrichosis
fungus infection
sphagnum moss
soil
temperature
Aspergillus
trees
tree handlers
Sporotrichum schenckii
climatic conditions
epidemic
Cryptococcus
microepidemics
foresters
histoplasmosis
humidity
farmer's lung
coccidioidomycosis

Disease/Solid Waste
Abstracts

No. DSW-101

**Author**

S. L. Chang and Paul Kabler

**Title**

Free-Living Nematodes in Aerobic

Treatment Plant Effluent

**Reference**

Journal Water Pollution Con. Fed.

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 34:1256-61 | | Dec 1962 |

**Abstract**

A study of effluents into the Ohio river from three trickling filter treatment plants, two primary settling plants and one stabilization pond showed a ratio of 100:10:1 nematodes per gallon among these types of treatment, respectively (2000-2500:200-500:20), with a large number of genera found in the first, a smaller number in the second and only a few in the stabilization pond effluent. Nematodes from the trickling filter process carried about 100 viable bacteria each; primary settling group 75 each and the stabilization pond population only 30 each (only small larvae present). Of these bacteria 5-10% were Coliform. Identifications were: Pseudomones sp.; Proteus Sp.; A. Aerogenes; E. Coli; Streptococcus sp; and Z. ramigera.

Salmonella, Shigella and Enteroviruses were not recovered by the methods used.

"The sewage treatment origin of nematodes in river water is indicated by the preponderance of members of the superfamily Rhobditoidea; the possibility that the effluent-borne nematodes are carriers of human enteric pathogenes is quite remote under normal conditions.

**Descriptors**

Aerobic treatment plant
Bacteria
Free-living Nematodes
Effluent

Disease/Solid Waste
Abstracts

No. DSW-102

Author

Robert E. Hodges, M.D. U of Iowa

Title

The Toxicity of Pecticides and their Residues in Food

Reference

Nutrition Reviews, Vol. 23, Aug 1965, No. 8

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 225 | | |

Abstract

The subject of pesticides residues and toxicity has been reviewed on numerous occasions in the recent past (Nutrition Reviews 18, 235 (1960); 19, 63, 227 (1961); 20, 52 (1962); 21, 1, 306 (1963); 22, 193 (1964).

Extensive reviews of pesticides toxicity and pesticide residues in food indicate that the Americal public has nothing to fear Toxicity resulting from pesticides occurs from improper use or from accidental exposure

The possibility of the occurrence of an unknown effect seems remote, judging from extensive animal studies.

The botanical preparation pyrethrum or its synthetic analogue allethrin can cause cutaneous or respiratory symptoms Anticoagulants which often are used as rodenticides seldom poison man and can readily be treated with vitamin K or with transfusions of whole blood Chlorinated hydrocarbon insecticides (including DDT) are widely used yet seldom cause illness. A few cases of acute poisoning have been described but "chronic poisoning has not been substantiated. These compounds, including Aldrin, Lindane, Chlordane, Chlorobenzilate, DDT, Dieldrin, Endrin, Heptachlor, Kelthane, Perthane, TDE, Endsulfan, Toxaphene, and the like, can be absorbed from the intestinal tract or the lungs or, of in solution, from the skin. Most reports of DDT intoxication have proved to result from the solvent, which frequently is kerosene.

Organic phosphate insecticides have been used widely in agriculture and are potentially very toxic. Parathion is the prototype (the group includes Bidrin, Chlorothion, Ciodrin, Navadel, Dematron, Diazinon, Disulfoton, Ethion, Guthion, Malathion, and others). Poisoning usually occurs quickly, during or shortly after exposure, but may come on as late as 12 hours afterward. Parathion must be converted into an active form (diethyl-p-nitrophenl phosphate) before symptoms occur. Other compounds are directly toxic.

Other pesticides are sold, but instances of poisoning are few. Herbicides such as 2, 4-D probably do not cause illness in man.

The frequency of occurrence of poisoning by pesticides was reviewed by

Descriptors

toxicity
pesticides
food

Abstract (continued)

W. J. Hayes, Jr. (Arch. Environ. Health 9, 621 (1964).

Mortality from accidental poisoning of all types in the early part of the twentieth century in the United States was four per 100,000. In the past 25 years this mortality rate has been constant at approximately two per 100,000. Somewhat more than one-half of these deaths resulted from solids and liquids, while the remainder resulted from gases and vapors. Pesticide deaths accounted for between 7.8 and 12.8 percent of all solid and liquid deaths, and less than 1 percent of all deaths resulting from gases and vapors. The annual death rate from pesticides was approximately one per 1,000,000 inhabitants of the United States.

There are perhaps 100 instances of morbidity for each person who dies of pesticide poisoning, and probably 90 percent of these are not hospitalized. It is estimated that almost 70 percent have no symptoms.

I. West (Arch. Environ. Health 9, 626 (1964) presented an indictment of these agricultural practices which permit contamination of our food, water, air and soil. She cited a case of serious intoxication in a small body who made mud pies from earth contaminated with parathion

It now is apparent that storage of chlorinated hydrocarbons in human fat has not been associated with any recognizable disease and, although it remains of academic interest, it should not be considered a threat to the public health.

Determination of the degree of hazard indicates "no evidence that the presence in the human diet of pesticide residues at or below the tolerance levels set on the basis of animal data, has had any adverse effect on the health of our citizens".

Pecticide toxicity results primarily from improper use, from accidental exposure, or from deliberate ingestion with suicidal intent.

**Disease/Solid Waste Abstracts**

No. DSW- 103

Author
J. H. McCoy

Title
River Pollution: Bacteriological Aspects and their Significance

Reference
Royal Society of Health Journal

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 83:154-162 | | May-June 1963 |

Abstract

Excellent discussion. Notes that sewage treatment is not selective in bacterial destruction so that "sewage effluent contains all the varieties of organisms, normal and pathogenic, present in the crude sewage before treatment, though in diminished numbers. A satisfactory effluent - satisfactory, i.e., in meeting the recommended chemical standards - may thus be clear, sparkling and free from offensive odor, but yet may contain large numbers of pathogenic organisms." Of the pathogenic organisms present in crude sewage, which consists essentially of human excreta suspended in the waste waters of the community, organisms of the Salmonella group, which are widely distributed in man and animals, are by far the most common. (These) organisms produce in man and animals a variety of infections ranging from acute septicemic fevers through acute intestinal infections to subclinical or symptomless infections in which the individual presents few signs or symptoms. . . but excretes the . . . organism."

In man by far the most important infection produced by salmonellae are the enteric infections, typhoid and paratyphoid fever, although food poisoning is in England and Wales by far the most common manifestation of salmonellosis. Salmonella of animal origin in towns are derived from trades and industries processing animals and their products for human or animal use. These sources include: abattoirs, butcher shops, the make-up meat industry, poultry processing plants, egg-breaking plants, bakeries, tanneries, knackers' premises, animal fat extraction plants, meat-meal and bone meal plants, animal feedingstuffs plants and fertilizer plants."

"In general, the pathogenic organisms from human sources are of greater importance than those of animal sources because man is the sole reservoir of typhoid and para-

Descriptors

Abattoirs
Animal feedingstuffs plants
Butcher shops
Bakeries
Fertilizer plants
Egg-breaking plants
Knackers' premises
Make-up meat industry
Meat-meal and bone-meal plants
Tanneries
Typhoid fever
Paratyphoid fever
Plants

Salmonella
Sewage
Sludge
Soil
Waste waters
Food poisoning
Poultry processing plants
Animal fat extraction plants

Abstract (continued)

typhoid bacilli and other organisms of dysentery and cholera. These organisms are incapable of infecting animals and animal infection plays no part in the propagation of these purely human diseases."

Survival of Salmonellae on plants (vegetation) and in the soil (3-7 days and up to 280 days respectively) is discussed . . . "Under natural conditions the disappearance of Salmonellae from polluted vegetables is slow and inconstant . . . etc., etc. (Use of sludge as opposed to crude sewage contaminants not discussed. Crude sewage and artificial (lab) contamination was used in the tests). The numbers of bacteria contaminating the vegetation or soil seemed to be the most important single factor in the disappearance of salmonellae from them.

Disease/Solid Waste
Abstracts

No. DSW-104

**Author**

N. S. Galbraith et al.

**Title**

Pet Foods and Garden Fertilizers as Sources of Human Salmonellois

**Reference**

The Lancet :372-4 (Feb. 17)1962

| Doc. No. | Contract No. | Date issued |
|---|---|---|

**Abstract**

Survey of garden fertilizers in England revealed 13% contamination with Salmonallae . . . "The risk is probably small." Concern expressed for permitting such fertilizers to be sold in shops selling food for human or animal consumption

**Descriptors**

Garden
Fertilizers
Salmonellae

No. DSW-105

Author
C. M. Tarzwell USPHS - Cincinnati, Ohio

Title
Aquatic Life Needs Protection

Reference
Chemical Engr. Progress 59:27-8 (Nov. 1963)

Doc. No. Contract No. Date issued

Abstract

The prime objective of aquatic biologists in the water pollution field is to set up water quality criteria essential for the protection and maintenance of aquatic life. In addition to determining necessary environmental conditions such as desirable levels of DO, PH, $CO_2$, temperature, alkalinity and hardness, we must also determine concentration of wastes and other potential toxicants. . . and consider the most sensitive species and the most sensitive stages in their life history. We are not interested in levels in which aquatic life can merely survive. . . it is in the extremes of the environmental conditions which we are determining.

The author states that, in view of the complexity of the problem, we cannot wait until definitive criteria are established for every one of thousands of species and thousands of waste components. We must establish and use tentative criteria if we are to save aquatic life as it now exists.

Descriptors
Aquatic life
Toxicants
Wastes
Water pollution
Water quality

Disease/Solid Waste
Abstracts

No. DSW- 106

Author

A. H. Wiebe

Title

Biological Survey of the Upper Mississippi River with Special Reference to Pollution

Reference

Bulletin U.S. Bureau Fisheries

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 43(2): 137-167 | | 1927 |

Abstract

(Data) . . . shows the river is grossly polluted for 49 miles below St. Paul; that there is some recovery within the next 15 miles (2 unpolluted tributaries enter in this stretch) and that within the next 46 miles recovery is complete. The absence of fish is definitely correlated with low dissolved $O_2$ content and abundance of pollutional forms in the bottom fauna.

Descriptors

Bottom fauna
Fish
Pollution
Upper Mississippi River

**Disease/Solid Waste Abstracts**

No. DSW-107

**Author**

D. L. Belding

**Title**

Toxicity Experiments with Fish in Reference to Trade Waste Pollutions

**Reference**

Trans. American Fish. Society

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 57:100-119 | | 1927 |

**Abstract**

The factors that must be considered in studying effects of pollution of water on fish are species of test fish, hardiness of individuals, age, and size. Environmental factors that must be controlled are chemical characteristics of water, size of containers, $O_2$ content and temperature of water. Brook trout, rainbow trout, chinook salmon, carp, goldfish and suckers were studied; brook trout of about 200 gm. are most satisfactory. $HNO_3$ HCl and $H_2SO_4$ produce the same symptoms of loss of equilibrium and irregular respiration at a pH of 4-5 (MLD is 1:100,000); organic acids present greater diversity of actions. Phenol is marked by its irritating action but produces no evidence of $O_2$ hunger. Tannic acid injures the gills and produces $O_2$ hunger. $NH_4OH$ and KOH differ only in degree of toxicity, but KOH is less marked in activity. Lead arsenate produced no characteristic symptoms. Ca hypochlorite produced characteristic head balancing motions. Cu $SO_4$ shows wide variation in toxicity; fish once poisoned do not recover in fresh water. $FeSO_4$ has low toxicity. $HgCl_2$ kills fish. . . $KMNO_4$ colors fish yellow but they promptly recover in pure fresh water. $H_2S$ produced respiratory paralysis, but fish can recover in fresh water.

**Descriptors**

Fish
Pollution
Toxicity experiments
Trade waste

**Disease/Solid Waste**
**Abstracts**

No. DSW-108

**Author**

L. R. Chevey

**Title**

Sur L'Interruption de la Montée des Savmons
par la Diminution de la Teneur du Cours D'eau
en Oxygène Dissous.

**Reference**

Compt.
Rend. Acad. Sci (Paris)

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 185(25) 1527-8 | | 1927 |

**Abstract**

The depletion of the salmon run in the river Dordogne is ascribed to the reduction in dissolved $O_2$ caused by the introduction of waste from paper mills. Previous investigations have shown that salmon do not enter streams in which the dissolved $O_2$ content is below 7cc/l. The water of the Dordogne above the paper mills shows . . . an $O_2$ content of 7-8 cc., but below, only 6 cc. Other fishes, such as the shad, have not been affected - a fact which indicates that the depletion of salmon is not the result of a toxic action of these trade wastes.

**Descriptors**

$O_2$ content
Paper mills
River
Salmon
Waste

**Disease/Solid Waste Abstracts**

No. DSW-109

**Author**
Fr. Dixon and L. J. McCabe

**Title**
Health Aspects of Wastewater Treatment

**Reference**
J. Water Pollution Control Fed.

| Doc. No. | Contract No. | Date. issued |
|---|---|---|
| 36:984-989 | | Aug. 1964 |

**Abstract**

The authors discuss (1) the possible existence of potential infectious organisms in raw sewage, (2) illness actually resulting from these agents and (3) proper evaluation of the work situation. Fungi potentially pathologic for man have been isolated from sewage. Because of the low morbidity generally, the authors feel their presence in sewage does not lead to a significant extra health hazard. Typhoid and Paratyphoid organisms are frequently recovered from sewage and are able to survive in sewage and sludge for long periods. Salmonella other than S. typhosa are frequently present. Shigella have caused numerous outbreaks of dysentery, although they are not often found (or cultured from) sewage. Leptospirosis organisma may exist in sewage or water, especially from areas frequented by infected rats or domestic animals. Mycob. Tuberculosis has been isolated from sewage and sewage treatment plant outfalls.

Parasites: Eggs of Ascaris lumbricoides (round worm) are found in sewage as may cysts of End. Histolytica. Viruses: Many enteric viruses may be present in domestic sewage - polio. Coxsackie, e. g. Infectious hepatitis has been transmitted to human volunteers fed a suspension of feces.

*All these agents are potential hazards to the sewage plant worker. Leptospirosis has occurred in English sewer workers. Infectious hepatitis occurred among construction workers at a sewage treatment plant. "A search of the literature shows no extensive surveys attempting to determine the actual incidence of infectious hepatitis in sewage workers and treatment plant operators." Sporadic cases are mentioned. Tuberculosis "must be considered because . . . 9 human cases reported were associated with near drownings in contaminated water."

**Descriptors**

Wastewater (treatment plants)
Wastewater (treatment plants) Worker
Sewage (treatment plants) Worker
Accidents
Injuries
Disease Hazards
Sewage
Fungi
Typhoid & Paratyphoid Fevers
Salmonella
Shigella
Leptospirosis
Weil's Disease
Roundwork
Ascaris Lumbricoides
Erdamoeba Histolytica
Poliomyelitis
Coxsackie Virus
Infectious Hepatitis
Sludge
Raw sewage

## Abstract (continued)

The authors suggest certain studies and mention some of the problems involved in attempting to relate disease to exposure among waste workers. A suggested physical and laboratory examination program is offered.

Summary - in spite of potential exposure, the actual incidence of infectious and parasitic diseases acquired (by sewage workers) from their work is probably not very high. The few cases of infectious hepatitis that have been found might represent chance appearance. More data are needed - illness rates should be studied among these workers.

Disease/Solid Waste
Abstracts

No. DSW- 110

Author
R. W. Miller, Chief, Epidemiol. Br. Field Studies, Nat'l. Cancer Institute

Title
Environmental Agents in Cancer

Reference
Yale J. Bio. and Med.

| Doc. No. | Contract No. | Date. issued |
|---|---|---|
| 37:487-507 | | June 1965 |

Abstract

This article generally discusses the application of epidemiol. methods to population to discover the etiology of cancer. It mentions one suspected agent, and this in association with possible fetal death, namely, N-methyl formacide, a solvent used in plastics and nylon manufacturing and 3 potential leukomogens - benzene, chloramphenicol and phenlybutazone. No relation of solid wastes to cancer or other disease is mentioned.

In the discussion, emphasis is placed on pre-natal hazards - the effect on nondisjunction of chromosomes by rubella virus, the resulting mongolism and later appearance of leukemia or Klinefelder's syndrome and later breast cancer in the male and cancer of the large intestine. It is noted that nondisjunction is a characteristic of malignant growth.

Descriptors
Environmental agents
Cancer
Carcinogens
Pre-natal hazards

Disease/Solid Waste
Abstracts

No. DSW-111

Author

H. H. Scott

Title

A History of Tropical Medicine (2 Vols.)

Reference

Williams & Wilkins, Baltimore 1939

Doc. No. Contract No. Date issued

Abstract

This book is very poorly referenced, many quoted statements and referenced material having no identification in the bibliography. However, it could be of interest if the quoted authors' material could be traced. It reads well and is highly interesting as history.

Descriptors

Disease/Solid Waste
Abstracts

No. DSW-112

Author

Carey P. McCord

Title

The Zooanthroponoses - As Occupational Diseases in the United States

Reference

Industrial Medicine and Surgery, V. 28,

Doc. No. Contract No. Date issued

April 1959 pp. 165-73

Abstract

.. All too infrequently is suitable information available as to the number or percentage of victims exposed at work. What is most striking of all is the lack of statistical information on occupational zoonoses in reports in compliance with the occupational disease reporting laws common to nearly all states and similar data in connection with the Workmen's Compensation Commissions. At least four factors militate against the acquisition of incidence information from these above mentioned sources: (1) In the majority of jurisdictions compensation coverage does not embrace agricultural workers; (2) In few states are the occupational disease reporting laws enforced; (3) In those jurisidctions wherein reporting approaches completeness compiling systems are such as to group all zoonoses under the general heading "Infections" or "Infections Not Otherwise Classified;" (4) Minor involvements of all occupational diseases leading to no disability or lost time seldom are registered. In fine, there are no official statistics that may be accepted as revealing the true frequency of zoonoses as occupational diseases.

A...sensible estimate of the situation is that in those areas in which there is a high development of the veterinary skills there comes about such proved frequency of the zoonoses that it may be assumed that an equal or greater incidence exists in many other localities.

...A publication in 1958 on psittacosis by Fred K. Laurentz, M.D., Director of Public Health of the City of Houston, Texas..alludes to 200 human cases in Texas in 1954 with exposure to turkeys constituting the source, but with no concise statement that all were of occupational origin, then refers to one Oregon psitacosis outbreak in 1956 in which there were 86 cases distinctly of occupational origin, being distributed over rendering plants, processing plants, farms and other rural facilities. Finally, the Laurentz paper is devoted to a psittacosis episode in

Descriptors

occupational diseases
trace diseases
occupational zoonoses
agricultural workers
psittacosis
erysipeloid
Mycotic infections
Mite dermatitis

rendering plant operators
zoo and circus attendants
Biological animal product workers
Workmen's Compensation
Leishmaniasis
Rat Mite Dermatitis

disease
veterinary physicians
jurisdictions
statistics
exposure
Q fever
Tularemia
Anthrax
Abattoir workers
butchers
stockyard workers
Professional hunters and trappers
Histoplasmosis
Creeping eruption
Coccidioidomycosis

zoonoses
workers
compensation coverage
brucellosis
turkeys
Erysipelothrix rhusiopathiae
Parasitic infections
Leptospirosis
wild animal ranchers
pet shop operators
Railway expressmen and ship crews
Garbage disposal workers

Ectopic Vacinia
military

Abstract (continued)

Houston in 1956 in which 29 laboratory confirmed cases with one death were recorded. No equivocation as to work origin is permissible since this language appears: "The persons affected were all from the slaughter lines of the two plants involved."

...E. Nelson...noted that he treated over 500 cases of erysipeloid. Two hundred sixty cases occurred among packing house employees, 144 among those in rendering plants, 84 in establishments handling hides and a few in butcher shops, restaurants and fish stores. Nearly all occurred on the hand.

Erysipeloid...is caused by Erysipelothrix rhusiopathiae.... The Ery, rhusiopathiae has a wide dissemination, and infections have been reported in men, swine, sheep, mice, cattle, pigeons, horses, rabbits, fish and domestic fowl.

This type of inquiry toward the determination of the incidence of the zoonoses as occupational diseases might be pursued almost endlessly and almost to encompass every form of that class of disease. An element of surprise attends some of this form of delving. For example...erysipeloid appearing among the scores of fish butchers in the ship's galleys.

...There is abundant evidence that precise investigations badly are needed, and to that objective the expenditure of public and private funds would be justified.

From the representation already set forth it must be concluded that any and all zooanthroponoses may appear as occupational diseases.

...It would be engaging here to list the 10 outstanding zoonotic occupational diseases in terms of their frequency of occurrence among workers. ...Crude signposts point to the following individual diseases or groups of diseases: Brucellosis, Psittacosis, Erysipeloid, Mycotic infections, Parasitic infections and infestations, Q fever, Tularemia, Mite dermatitis, Anthrax, Leptospirosis.

Among those more directly to be regarded as in industrial pursuits but not here listed in any order of importance are:

Agricultural workers including farmers, animal husbandry men, ranchers
Abattoir workers in all branches, wild animal ranchers, rendering plant operators, butcher, pet shop operators, zoo and circus attendants
Railway expressmen and ship crews
Biological animal product workers
Professional hunters and trappers
Garbage disposal workers
Stockyard workers

Rat Mite Dermatitis. In winter months in cold climates one of the more common zoonotic occupational health difficulties centers about episodes of rat mite dermatitis. ...Stockrooms with their diverse accumulations are favored. Repeatedly, outbreaks of highly pruritic dermatitis with lesions frequently are found in women in the brest region, in men under belts or suspenders and at times under socks.

Leptospirosos: In the military sphere D. G. Levis recorded 291 cases, caused by a variety of serological types, among troops on jungle patrol in Malaya in 1954-1955, and in one operation in Viet Nam 126 men, nearly one-quarter of the effective force, were incapacitated by the disease.

Disease/Solid Waste
Abstracts

No. DSW-113

Author

E. C. Faust

Title

Amebiasis in the N. O. Population as Revealed by Autopsy Examination of Accident Cases

Reference

Amer. J. Tropical Med., 21(1):35-48 1941

Doc. No. Contract No. Date issued

Abstract

Endamoeba histology found in 13 of 202 cases. Other parasitic infections were found. 42 cases were plus for one or more parasites.

Descriptors
Amebiasis
Endamoeba histology

Disease/Solid Waste
Abstracts

No. DSW-114

Author
J. E. Tobie

Title
Pathogenicity of "Carrier" Strains of E.

Histology in the Experimental Dog

Reference

Proc. Soc. Ex. Biol. and Med.

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 45(2):691-3 | | (1940) |

Abstract

Sixteen "carrier" strains from apparently healthy individuals were tested for their pathogenicity in 26 dogs. All dogs became infected and all showed amebic lesions at autopsy.

Descriptors

Endamoeba histology
Dog

Disease/Solid Waste
Abstracts

No. DSW-115

Author

I. Martini

Title

Sulla Presenza di Leptospire Patogenie . . etc

Reference

Clinical Vet. (Milan)

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 62:468-76 | | Aug 1939 |

Abstract

Of fifty sewer rats examined, 16 were infected with Leptospira icterohaemorrhagiae pathogenic for guinea pigs and dogs. Two young swine were artifically infected.

Descriptors

Disease/Solid Waste
Abstracts

No. DSW- 116

**Author**
B. Babudieri

**Title**
Reserche Sulla frequenza del 'infezoine de Leptospira Nei Cani di Roma (Frequency of Leptospira in Roman Dogs)

**Reference**
Ann. Hygiene 50(4):145-62 1940

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | | |

**Abstract**

Sera of 159 dogs tested for Leptospira agglut. (various strains). Positive tests obtained in 57 (35.9%) cases. Most were for L. ictero-haemus. In 25, the titre was not over 1/100. Culture was unsuccessful (inoc. into kidneys of g. pigs). It is necessary to use varied and numerous strains of Lept. for studies of this type.

**Descriptors**

Disease/Solid Waste
Abstracts

No. DSW-117

Author

D. F. Gray

Title

Canine Leptospira Jaundice in Queensland

Reference

Austral. Vet. J. 16(5):200-3 1940

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Abstract

Case recorded intense jaundice. Source of infection not conclusively demonstrated.

Descriptors

Disease/Solid Waste
Abstracts

No. DSW-118

Author

Mochtar, A. (Dutch)

Title

Occurrence of Leptospirosis in Pigs

in Batavia

Reference

Geneesk, Tajdschr. Nederland - Indie

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 80(40):2334-45 | | 1940 |

Abstract

Six leptospirosis strains were cultivated from the kidnesy of 104 pigs; the organisms showed little virul. for guinea pigs and white mice. Serd.-Pomons type, etc.

Descriptors

Leptospirosis
Pigs

Disease/Solid Waste
Abstracts

No. DSW-119

Author

V. Varvello (Italian)

Title

The Presence of Various Types of Leptospirosis in Rats in the Region of Vecelli

Reference

Ann. Igiene 50(4):163-8 1940

Doc. No. Contract No. Date issued

Abstract

Of 60 rats investigated 24% were carriers of Leptospirosis ict.-hem. Guinea pig inoculation permitted serol. identification of Leptospirosis mit. Bataviae. This organism has been implicated in a leptospirosis of rice-field workers.

Descriptors

Leptospirosis
Rats

Disease/Solid Waste
Abstracts

No. DSW-120

Author
William R. Horsfall

Title
Medical Entomology: Arthropods and
Human Disease

Reference
Ronald Press Company, New York 1962

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Abstract

(Book not helpful in establishing solid waste/disease relationships).

Sample quote (without references): "Its exact role (re M. domestica) in the etiology of human diseases may never be fully known and undoubtedly varies according to the relative incidence of the flies. Situations where enteric diseases are endemic usually have sanitary conditions which also permit extensive development. Once the sanitation is good, incidence of both disease and flies declines." (p. 150)

Descriptors

Entomology
Arthropods
Disease
M. domestica
Flies
Enteric diseases

Disease/Solid Waste
Abstracts

No. DSW- 121

Author
G. S. Graham-Smith

Title
Flies in Relation to Disease: Non-Blood Sucking Flies

Reference
Cambridge Public Health Series

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Cambridge University Press | | 1913 |

Abstract

(Preface p. viii) - "The work done up to the present has been mainly of a preliminary character. It has, however, established pertinent very important facts; that many of the non-biting flies found in houses frequently walk over and feed on decaying substances and excreta of all kinds and that their larvae develop in them; that occasional disease-producing bacteria may be present in the excreta; that flies can carry bacteria on their limbs and bodies for several hours and internally for several days; that for some days they can infect substances, including human food materials over which they walk or defecate and on which they feed . . .Further the epidemic evidence suggests that, when suitable conditions prevail, flies may be highly important factors in the spread of certain infectious diseases." . . . "Far-reaching conclusions founded on insufficient data at present available can fulfill no useful purpose . . . . . . It may be justly claimed, however, that a very strong case has been made out for the thorough investigation of the relation of non-biting flies to disease." (p. viii) . . . In order to determine with any degree of certainty the part really played by flies, we need more particularly a large amount of epidemic evidence, such as would be afforded by changes in disease incidence following the control of the fly nuisance. At present there is very little such evidence, and until recently there was none. Vague surmises have been plentiful, but trustworthy observations few." (p. ix) . . . In this book an attempt has been made to collect the most important and reliable information on the subject . . ." (p. ix).

Chapter XII, Flies and 'Specific' Diseases, contains a critical approach to the demonstration of fly-disease relationships and points out the difference between fly-contamination with laboratory cultures of organisms and natural contamination,

Descriptors

Flies
Disease
Excreta
Bacteria
Typhoid fever
Dysentery
Paratyphoid
Food poisoning
Summer diarrhea
Cholera
Tubercle bacilli
Anthrox
Diphtheria
Ophthalmia
Small-pox
Tropical sore
Trypanosonniasis
Yaws
Parasitic worms

Abstract (continued)

the fact that earlier bacteriology methods for identification of species were not "so complete as at present." It criticizes some earlier general observations for lack of evidence; the ignoring of other possible sources of infection in outbreaks of disease and poor statistical control (p. 125). However (p. 126), the author states, ". . . in a few instances the evidence appears to be conclusive." The difficulty in differentiating "B. typhosis" from other bacteria in the fly is noted (p. 129).

The author quotes several investigators prior to 1910 in concluding "as a whole these observations seem to indicate that there is little relationship in these (temperature zone) cites between the prevalence of flies and the incidence of typhoid fever." (P. 135). Niven (1910) and Lennoden and Anderson (1911) felt that there was such a relationship, the latter in regard to population in Washington, D.C. who used privies (p. 135). In the tropics, numerous references are made with respect to coincidence of "enteric fever" with the appearance of the flies causing outbreaks and the disappearance of the disease with that of the flies. (pp. 136-142). He notes, as does Hewitt in "The House-fly" (1913), the apparently conclusive causal relationship between flies and typhoid fever in the military camps at the turn of the century (pp. 1 2-145) Grahm-Smith concludes, "The reports relating to military camps in war time show very conclusively that flies are under those conditions the principal agents in spreading the disease (typhoid fever)" (p. 146).

As to dysentery, paratyphoid and food poisoning, the author states, "No instances of infection by flies have yet been recorded" (p. 148). On summer diarrhea, in his summary (p. 172) he says, "The epidemic and bacteriological evidence is so suggestive . . that an attempt to definitely settle the connection between flies and summer diarrhea by preventive measures against flies in a selected area seems now justifiable." As to cholera, he feels that further evidence is required to make the fly-disease association (p. 175). He notes that flies can carry tubercle bacilli, but that "in considering this relation to infection in the human subject the influence of dose must be taken into consideration." (P. 179). In regard to anthrox, " . . under suitable conditions, which are not frequently fulfilled the bacillus may be distributed by flies in many ways, though no definite evidence of infection either in men or animals has yet been obtained." (P. 186). On diphtheria, "There is no evidence that under natural conditions flies are concerned in the spread of this disease, which is usually prevalent when flies are numerous, but, under suitable conditions, it is possible that the disease may be occasionally conveyed by them," (p. 186). On ophthalmia (quoting Howe (1888)), ". . . the extraordinary prevalence of purulent ophthalmia among natives up and down the river Nile, and to the extraordinary abudance of the flies. . .    . . . The eye trouble is the most prevalent in the place where flies are most numerous, . . . examination of the flies captured upon diseased eyes (revealed) on their feet bacteria which were similar to those found in the conjunctival secretion", (p. 188). The author quotes Nuttall and Jepson (1909) as stating that evidence of the spread of Egyptian ophthalmia by flies seemed conclusive, (p. 188). In regard to polio, he says, " . . up to the present, we have little knowledge of what part (flies) play in the dissemination of the disease" (p. 190). Flies and their relation to small-pox, tropical sore, trypanosoniasis and yaws are discussed in the same vein (p. 190-194).

Abstract (continued)

Similarly, the dissemination of parasitic worms (summary P. 209). The book is generally summarized on pp. 256-263. The bibliography covers pp 264-280. Many of the references duplicate those of Hewitt (1913 - The House-fly).

Disease/Solid Waste
Abstracts

No. DSW-122

Author
D. W. Metzler

Title
III
Environmental Health Practices in the Soviet Union

Reference
Royal Society of Health Journal

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 85:3-5 | | Jan-Feb 1965 |

Abstract

Solid waste note: "The collection and disposal of solid wastes was a well organized service in the cities visited. Collection practices varied even within the same city, but were generally similar to practices in the U.S. Trucks with packer type bodies were used . . . . . "

References (Russian) - Titles not suggestive of solid waste information.

Descriptors
Environmental health practices
collection
disposal
solid wastes

Disease/Solid Waste
Abstracts

No. DSW- 123

|  |  |  |
|---|---|---|
| Author<br>E. A. Drew |  |  |
| Title<br>Sewage Treatment and Trade Effluent<br>Control |  |  |
| Reference<br>Royal Society of Health J. |  | May-June 64 |
| Doc. No.<br>84:159-163 | Contract No. | Date issued |

Abstract

Discussion of the "kind of problem arising in sewage purification from the reception of trade effluents" - (making it) "far more difficult to treat . . ." (Note implications for effect on sludge composition and eventual treatment of sludge).

Classes of trade effluents are discussed with respect to their inhibiting or toxic effects on either or both of the biological processes at the sewage works, i.e., the secondary treatment of the effluent and/or the digestion of sludge.

References:

National Farmers Union (1963) June - Farm Effluent Disposal
Rudolfs, W. (1953) Industrial Wastes, 293.

Ludzack, F. J. and Mandia, J. W. (1961) Proceedings 16th Industrial Waste Conference - Purdue University, Engineering Extension Service No. 109, 540.

Institute of Civil Engineers, "Safety in Sewers and at Sewage Works"

Descriptors

Sewage treatment
Trade effluent

Disease/Solid Waste
Abstracts

No. DSW- 124

Author
J. W. Corran

Title
Avoidable Contamination of Packeted

Foodstuffs

Reference
Royal Society of Health Journal

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 83:184-188 | | July-Aug. 63 |

Abstract

This article has implication for solid waste/disease relative in that it estimates (in Great Britain) 5% of foodstuffs are rendered inedible by insect infection. For cereals, dried fruits, and nuts, this would amount to more than 500,000/year conservatively. Such food would have to be dispcsed of, probably as solid waste. No implication for spread of disease through such waste is discussed. Successful control methods are discussed.

Reference:

Minister of Agriculture, Fisheries and Food - Insect Pests in Food Stores, Advisory Leaflet 483 (1960).

Descriptors

Disease/Solid Waste
Abstracts

No. DSW-125

**Author**

Charles T. Brues

**Title**

Insects and Human Welfare

**Reference**

Cambridge University Press 1920

**Doc. No.** **Contract No.** **Date issued**

**Abstract**

This is a very general discussion, unreferenced, and without significant contribution to a definitive study of the relation of insects to human disease.

**Descriptors**

Insects
Human welfare

Disease/Solid Waste
Abstracts

No. DSW-126

Author

M. Nakamura, R. L. Stone, J. E. Krubsack

Title Montana State University, Missoula

Survival of Shigella in Sea Water

Reference

Nature, No. 4941, July 11, 1964, pp. 213

Doc. No. Contract No. Date issued

Abstract

The survival of enteric bacteria in sea water has been extensively investigated (1-5). However, there is a paucity of information on the survival of Shigella in sea water.

The Shigella strains used in these experiments were isolated from Eskimos in Alaska.

In general, the ogranisms did not survive as long in natural, untreated sea water as compared with autoclaved or filtered sea water. There was a wide variation in the ability of different strains to survive in untreated sea water, that is, strain 12403 survived only 15 days.

The Shigellae were quite resistant to the osmotic effects of high concentrations of sodium chloride. However, survival depended a great deal on the holding temperature. For example, the cells survived for more than 25 days at $-13^{\circ}C$ and for only 4 days at $37^{\circ}C$ at varying concentrations of sodium chloride.

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(1) ZoBell, C. E., Marine Microbiology (Chronica Botanica, Waltham, Mass., 1946).
(2) Pearson, E. A., State Water Pollution Control Board, Std. Serv. Agreement No. 12C-14, State of California (1955).
(3) Greenberg, A. E., Public Health Rep., 71,77 (1956).
(4) Terry, R. D., Allan Hancock Found., Univ. Southern Calif. (1956).
(5) Carlucci, A. F., and Pramer, D., App. Microbial, 7, 388 (1959).

Descriptors

sea water
enteric bacteria
Shigella
survival

Disease/Solid Waste
Abstracts

No. DSW- 127

Author

M Rubhun, San Eng. Lab., Technion-Israel Inst. of Technology, Haifa, Israel

Title

Salinity Increments in Municipal Sewage, Their Significance and Sources and Methods of Reduction

Reference

Int J. Air Wat. Poll. 1965. Vol. 9, pp. 253-261.

Doc. No. Contract No. Date issued

Abstract

Salinity increments in municipal wastes and their significance in the re-use of treatment plant effluents are discussed. Sources of salinity were analyzed and their relative contribution to total salinity increment evaluated. Units such as g/capita/day rather than mg/l should be used as general measure of salinity increment. The increment from domestic use only was found to be 7 g chloride/capita/day in different places surveyed. Industrial wastes and spent regeneration brines from ion-exchange water softeners were found to be major contributors to the minicipal waste water salinity, their contribution considerably exceeding that derived from domestic sources. Proposals for minimizing the salinity increase are presented.

Descriptors

salinity
industrial wastes
regeneration brines
municipal waste water

Disease/Solid Waste
Abstracts

No. DSW-128

Author

S. W. Horstman, R. F. Wromble, A. N. Heller

Title R. A. Taft, S.E C. Cincinnati, Ohio

Identification of Community Odor Problems by Use of an Observer Corps.

Reference

Jrl. Air Pollution Control Asso Vol. 15, No.6

Doc. No. Contract No. Date issued

June 1965, pp. 261

Abstract

To evaluate the major odors affecting a community, approximately 120 high school students recorded odor observations. Simultaneous odor observations were made three times daily for 14 consecutive days each in a fall and spring survey. The observers were tested for olfactory sensitivity, and population characteristics were recorded for analyses of the human variables. These data were analyzed to show the areas most severely affected, the major objectionable odor types, the time when odors were most frequent, and the associated weather parameters. A critique of the procedures employed and the results of the survey are presented.

A working definition of an offensive odor may be: an odor that is objectionable to a majority of healthy persons exposed to its olfactory action.

The sensitivity of the individual observer varies from day to day, but the overall sensitivity of a group of observers is reasonably constant.

The sensitivity of smell is rapidly fatigued, though fatigue for one odor does not necessarily affect the perception of dissimilar odors.

Responses to odors are not completely objective since psychological responses vary in different observers.

The sensitivity of observers varies widely

Meteorological factors influence the reported levels of odors, and wind speed and vertical temperature gradients influence the dilution of odors in the air.

Topography may affect the transport of odors.

The study of the interstate air pollution problem in Lewiston, Idaho, and Clarkston, Washington, was begun during the winter of 1961-1962. The largest single source of air pollutants in the valley is a kraft pulp mill whose atmospheric emissions are reported to cause reduced visibility, deterioration of materials, undesirable odors, and suspected adverse effects on the health of citizens.

Since pulp mill odors were of primary interest in this survey, analysis of the results was largely confined to this category. Presence of several other odor categories was reported frequently; Type 2 (smoke, wood smoke), Type 3 (burning leaves), and Type 0 ( flowers).

Descriptors

pulp mill
smoke, wood smoke
burning leaves
musty
gasoline
rendering plant
rubbish burning
animal odors
misc odors

kraft pulp mill
topography
meteorological factors
sensitivity
fatigue
psychological responses
odor
community

Disease/Solid Waste
Abstracts

No. DSW-129

Author

Gunnar Biörck, Harry Boström and Anders Windström

Title

On the Relationship Between Water Hardness and Death Rate in Cardiovascular Diseases

Reference

Acta Medica Scandinavica, Vol 178, fasc. 2, 1965

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 239-252 | | |

Abstract

SUMMARY

A study has been made on the relationship between deaths from cardiovascular diseases and various parameters in drinking water in 34 Sweedish towns during 1951-60.

The figures indicate a highly significant negative correlation between the calcium ion concentration and the statistical group 422 ("other degenerative heart diseases").

Essentially the findings confirm results of similar studies from other countries. It does also raise the problem of the medical significance of the group 422. - 16 references.

Descriptors

water hardness
death rate
cardiovascular diseases

Disease/Solid Waste
Abstracts

No. DSW-130

Author

O G. Hughes

Title

Refuse Storage in Multi-Storey Buildings

Reference

Royal Society & Health Jrl. 6, 1964

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 319-322 | | |

Abstract

Chutes will be constructed in the future and they must be designed and used so as to obviate the main objections which most often arise on the grounds of smell, fires, blockages and noise.

The Report of the Director of Fire Research 1962 states that "The largest single cause of fires in London flats (of over three storey height) were due to careless disposal in dust and refuse chutes". Noise can be largely eliminated by careful positioning, so that the chute is not contiguous with bedrooms or living rooms. It is often not appreciated that noise travels surprising distances vertically but the use of materials of low sound transmission and sound deadening materials will help a great deal.

REFUSE - Tests carried out by the author and published elsewhere show that from centrally heated flats and those heated entirely by electricity, the density of refuse is approximately 1-1/4 cwts per cu yd; or in other words an average binful weighing 13 lbs!

The growth and expansion of the packaging industry are reflected very fully in problems of storage and collection of refuse, the high proportion of refuse made up of packages.

Descriptors

Disease/Solid Waste
Abstracts

No. DSW-131

Author

John S. Wiley, Tom D. Y. Chin, Clifton R. Gravelle and Sherry Robinson

Title

Enterovirus in Sewage During a Poliomyelitis Epidemic

Reference

Jrl. Water Pollution Control Federation, Feb. 1962

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 168-178 | | |

Abstract

SUMMARY

Sewage sampling by the gauze-pad method was conducted in eight areas during the 1959 Des Moines poliomyelitis epidemic. Overall recovery rates in 12 sample series were : 59.6 percent for poliovirus type I. 7.4 percent for ECHO viruses, and 3.2 percent for type III poliovirus. Enterovirus isolations varied from 0 to 100 percent by sampling area, corresponding with case rates in the various socio-economic areas. The recovery rates for type I poliovirus from sewage varied from 37.5 to 75.0 percent in different weeks. There appeared to be fairly abrupt die-away of viruses in the sewage in three of the eight areas, with initial die-away occurring first in the "hot" area of the epidemic.

The sewage sampling technique proved to be an extremely valuable tool in the epidemiology study of the epidemic, and it may be sufficiently sensitive to be useful in an enterovirus surveillance program.

Descriptors

ECHO viruses
enterovirus
sewage
poliomyelitis

Disease/Solid Waste
Abstracts

No. DSW-132

Author

Title

Many Trace Elements Affect Animal Nutrition

Reference
Chem. & Eng. News
May 16, 1966, p.48-50

Doc. No. Contract No. Date issued

Abstract

Evidence obtained by many different laboratories in recent years indicates that trace quantities of zinc, fluorine, copper, manganese, cobalt, chromium, arsenic, and selenium each play an important role in animal nutrition.

Zinc deficiency in several animal species, including man, retards growth and causes testicular atrophy

Selenium exhibits a "Dr Jekyll and Mr Hyde" effect in animal nutrition. Above 5 to 14 ppm in the died, the element is highly toxic to animals. But below about 3 ppm in the died, selenium improves growth in sheep.

Rats fed excess selenium for long periods may develop low-grade liver tumors. This places the element in the category of a carcinogen.

The first known carcinogen is often erroneously said to be arsenic. No one has succeeded in causing experimental cancer with any arsenical, but still the belief persists.

Many natural foods, particularly seafoods, contain more than 1 ppm of arsenic. Fish and even potatoes often contain more than 1 ppm of arsenic. And crustaceans usually contain 3 to 100 ppm.

Arsenic is ubiquitous in nature. Soil, air, water, plants, and animals all contain traces of the element.

The development of a congenital genetic defect has been prevented in the offspring of mutant mice by giving their mothers a diet high in manganese during pregnancy.

Congenital abnormalities of the ear have also been found in manganese-deficient guinea pigs.

Fluorine and cobalt are other trace elements known to play specific roles in animal or human nutrition. Fluoride ion's ability to reduce tooth decay is well established. Cobalt is a component of vitamin $B_{12}$.

Descriptors

trace elements
animal nutrition
zinc
fluorine,
copper
manganese
cobalt
chromium
arsenic
selenium

Disease/Solid Waste
Abstracts

No. DSW-133

Author
Report of a Working Party of the Public Health Laboratory Service

Title
Salmonellae in abattoirs, butchers' shops and home-produced meat, and their relation to human infection

Reference
J. Hyg. Camb. (1964), 62, 283 (Britain)

Doc. No. Contract No. Date issued

Abstract

## SUMMARY

In 1961 and 1962 a Working Party of the Public Health Laboratory Service, in which twenty-two laboratories participated, investigated the occurrence of salmonellae in abattoirs, meat factories, butchers' shops and meat products, and their association with human infections.

Thirty-two abattoirs were studied. Salmonellae were isolated from 930 (21%) of 4496 swabs of abattoir drains. There was great variation between different abattoirs, but in general salmonellae were found most frequently in those which slaughtered a high proportion of cattle and a low proportion of sheep; more serotypes were isolated from bacon factories than from abattoirs which slaughtered more than one species of animal. Of 11,347 tissue specimens collected at abattoirs, 218 (1.92%) yielded salmonellae.

Drain swabs from butchers' shops were examined and 73 (6.5%) of 1117 swabs were positive. Meat and meat products were less commonly contaminated but 0.8% of 4127 samples yielded salmonellae.

Salmonella typhimurium was the sertype isolated most frequently from all sources. It was often shown that the same serotypes or phage-types were occurring in abattoirs and in human cases in an area at the same time. In eight food-poisoning incidents, involving a total of 281 cases and excreters, there was convincing evidence that meat or a meat product was the vehicle of infection; in a further twenty-three incidents the organisms causing disease were isolated from sources which suggested that infection might have been meat-borne.

The evidence collected suggests that cattle introduce salmonellae into abattoirs more often than other species of animals. The importance of pigs as a source of human infection is confirmed. Sheep are not a source of salmonella infection in man from meat and meat products, whereas meat from pigs, cattle and calves is a source of infection and is responsible for both sporadic cases and outbreaks of disease.

Descriptors

Salmonaellae
abattoirs
butchers' shops
meat
human infection
cattle
sheep
food-poisoning
pigs

No. DSW- 134

Author

Elena M. Sliepcevich, Springfield College, 1955

Title

**Effect of Work Conditions upon the Health of the Univormed Sanitationmen of New York City**

Reference
Library of Congress Publication no. 20,008

Doc. No. Contract No. Date issued

Abstract

Part I - Vertical Study

The permanent medical records of each of the 500 men who entered the Sanitation Department as refuse collectors in 1931 were evaluated for specific diseases and injuries which could be classified as occupational.

Part II - Cross-Sectional Study

The weekly medical reports of the 8,528 refuse collectors who were in the employment of the Sanitation Department during 1952 were the source of data for this part of the study.

Results - There is no relationship between hemorrhoids, carciovascular diseases, and skin diseases and the season of the year. Fifty-seven percent of the refuse collectors in the 500-man groups were reported as having arthritis, which exceeded the national average. Cardiovascular diseases exceeds rates for all other groups of similar ages. The prevalence of muscle and tendon diseases among refulse collectors is high, particularly, muscle ailments affecting the back. Skin diseases may be classified as occupational for the refuse collector. There is no relationship between the number of injuries and the season of the year. In the 500-man group 15.2 per cent were reported to have, or have had hernias. The average rate of injuries per million man-hours for the New York City Sanitationmen was 69.2 which exceeds that of all other occupations previously studied, except logging. The present rate (1951-March 15, 1953) of 48.8 is exceeded only by the stevedores and loggers.

Descriptors

work conditions
health
sanitationmen
refuse (collection)
diseases

Disease/Solid Waste
Abstracts

No. DSW-135

Author

J. E. Hawley. L. R. Penner, S. E. Wedberg and
W. L. Kulp

Title

The Role of the House Fly, Musca Domestica, in
the Multiplication of Certain Enteric Bacteria

Reference

Amer. Jrl Tropical Medicine & Hygiene, V. 31,1951

Doc. No. Contract No. Date issued

Abstract

Of 132 Musca domestica investigated in controlled feeding experiments, 36 were fed known numbers of Escherichia coli, 48 were given measured amounts of Salmonella schottmulleri, and a third group of 48 flies received known numbers of Shigella dysenteriae in an effort to determine pasage of the test species bacteria through the digestive tract of the flies.

Flies in groups of twelve fed small numbers (less than 1000) of the specified organisms in a single feeding apparently do not pass these bacteria in their stools, but as the numbers of ingested bacteria increase, decided multiplication occurs within the insects as evidenced by the excretion of significantly greater numbers of the test species than were initally fed. This excretion remains at a high level for at least six days, but the death of many of the flies limited the length of the observation period.

Descriptors

house fly
musca domestica
enteric bacteria

Disease/Solid Waste
Abstracts

No. DSW- 136

Author

R. W. Crain

Title

A Realistic Approach to Waste Treatment

Reference

Proc. 9th Ontario Indus. Waste Conf., 1962, 57-64.

Doc. No. Contract No. Date issued

Abstract

The new plant of Flexonics, a division of Calumet and Hecla, Inc. is situated in the village of Bartlett, Ill The waste waters comprise rinses and concentrated dumps of nitric and hydrofluoric pickling baths, alkaline cleaners, and sulphuric, citric and chronic acids, and could not be discharged to the small municipal sewage works since they would interfere with biological treatment. Plant was therefore installed to treat the waste waters. Chromate waste waters are reduced with sulphur dioxide under acid conditions, and acid and alkaline waste waters are mixed and neutralized with lime if necessary; the mixed waste waters are then filtered in diatomaceous-earth pressure-leaf filters. The filter cake is dried with a blast of air and disposed of by dumping. The final effluent is clear, contains less than 1 ppm suspended solids, and is lower in dissolved solids than the original well water owing to the lime-softening effect that occurs in the filters; it is suitable for direct discharge to a creek, but consideration is also being given to the possibility of re-using it in the rinsing tanks.

Descriptors

nitric
hydrofluoric
pickling baths
alkaline cleaners
sulphuric
citric
chromic
acids
waste waters
dumping
filter cake

Disease/Solid Waste
Abstracts

No. DSW- 137

Author

K. Jarl and M. Tveit

Title

A Method for Removal of Starch from Industrial Waste Liquids, by Symbiotic Cultivation of Yeasts

Reference

Socker, 1963, 18, 25-28

Doc. No. Contract No. Date issued

Abstract

A method is described for the treatment of food industry waste waters containing a high percentage of starch, and particularly those from the potato-processing industry where the method can be used to treat both the starch-containing waste waters and reject potatoes , the hydrolysis and yeast cultivation being carried out in the same batch. The yeast suspension is then concentrated in separators, and finally dried to give a valuable product in which the yeast portion is principally Candida utilis.

Descriptors

yeast
starch

cultivation
removal

industrial waste

Disease/Solid Waste
Abstracts

No. DSW- 138

Author

Bianucci, G., and Stefani, G. D.

Title

Tannery Wastes

Reference

Effl. & Wat. Treatm. J., 1963, 3, 18-22 and 78-80.

Doc. No. Contract No. Date issued

Abstract

In a review of methods of treatment of tannery wastes, the authors discuss the problems involved in removal of fleshings and other organic matter, sulphide, chrome, lime and dyestuffs, and described a methods of removing hydrogen sulphide by stripping with flue gas in a carbonation plant, and a Czech technique in which the different wastes interact to produce a heavy precipitate in sedimentation tanks. Separate and combined methods of treatment are compared.

Descriptors

treatment
tannery waste

Disease/Solid Waste
Abstracts

No. DSW- 139

Author

A. B Wheatland and B. J. Borne

Title

Treatment of Farm Effluents

Reference

Chemistry and Industry, Feb 29, 1964

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 357-362 | | |

Abstract

The volume and strength of the wastes depend very much on the way in which the animals are housed. With some methods of housing-for example, the covered yard for cattle, the deep-litter system for poultry, and the system of yarding pigs in straw-there may be little or no piped discharge of effluent.

Cleaning of cowsheds is usually begun by brushing the dung into the gutters, and removing it either to a manure heap or directly into a manure spreader, (about 3/4 $ft.^3$ dung per cow per day).

It is generally assumed that a cow produces about three gals., a calf one and a half gals., a horse one gal. and a pig one-third of a gal. of urine per day or about two gals. water per pig per day are used in washing down.

Studies by the Water Pollution Research Laboratory indicated that the washings averaged about 8.25 gals. per cow per day and had a BOD of 4330 ppm. On the basis of BOD they were equivalent in polluting character to about 89 gals average crude domestic sewage per cow per day.(3)

At another research station washings from one eight-cwt. heifer were judged to be equivalent to 22.5 gals average crude domestic sewage on the basis of BOD or 78 gals on the basis of permanganate value.

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(3) Pettet, A. E J. & Jones, E. E. J. Inst. Sew. Purif., 1946, Pt 2, 190.

Descriptors

farmyard sewage
treatment
farm effluents
milking parlours
cowsheds
piggeries
analysis of cow urine and dung
disposal
biological treatment
septic tanks
chemical treatment
silage liquor

## TABLE I

Volume and Composting of Waste Waters from Cowsheds and Milking Parlours
Values are based on the analysis of 24-hour composite samples of the drainage during dry weather.
Drainage from yards is not included
Values in brackets are for samples settled one hour.

| Farm | Number of cows | Method of [illegible] | Volume (gal/cow day) | 5-day B.O.D. p.p.m. | 5-day B.O.D. lb/cow/day | 4-hour permanganate value N/80 p.p.m. | 4-hour permanganate value N/80 lb/cow/day | Suspended solids p.p.m. | Suspended solids lb/cow/day | Organic carbon | Total nitrogen | 4-hour permanganate value N/8 | McGowan strength † |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  |  | (p.p.m.) |  |  | (p.p. 10⁵) |
|  |  |  |  | *Milking Parlour and Dairy* |  |  |  |  |  |  |  |  |  |
| H10 | 80 | B C Ho | 4·4 | 2070<br>(1660) | 0·09 | 950<br>(650) | 0·04 | 2330<br>(930) | 0·10 | 1080 | 660 | 1160 | 1051 |
| H 9 | 44 | C Bu • | 6·5 | 1170<br>(1050) | 0·08 | 391<br>(312) | 0·03 | 1660<br>(870) | 0·11 | 1140 | 394 | 657 | 603 |
| H 7 | 38 | B C Ho • | 6·0 | 455<br>(440) | 0·03 | 265<br>(185) | 0·02 | 1360<br>(640) | 0·08 | 620 | 254 | 412 | 382 |
| H 1 | 135 | B C Ho | 1·7‡ | — | 0·015‡ | — | 0·005‡ | — | 0·02‡ | — | — | — | — |
| H15 | 133 | B C Ho • | 9·4* | 2120<br>(1850) | 0·22 | 1660<br>(940) | 0·16 | 5590<br>(2545) | 0·56 | 4200 | 586 | 1930 | 1518 |
|  |  |  |  | *Cowshed and Dairy (a) Cows brought in for milking twice per day* |  |  |  |  |  |  |  |  |  |
| H 3 | 34 | C Ho | 25·0 | 540<br>(439) | 0·13 | 220<br>(184) | 0·05 | 700<br>(340) | 0·18 | 655 | 177 | 275 | 258 |
| H11 | 60 | C Bu | 28·3 | 198<br>(171) | 0·06 | 191<br>(122) | 0·05 | 875<br>(395) | 0·25 | 480 | 100 | 304 | 242 |
| H12 | 87 | B C Bu | 7·9 | 819<br>(732) | 0·06 | 655<br>(320) | 0·05 | 2670<br>(940) | 0·21 | 1480 | 211 | 832 | 615 |
| H 5 | 35 | R Bu | 5·1 | 2170<br>(2120) | 0·10 | 1290<br>(980) | 0·05 | 3780<br>(2080) | 0·11 | 2260 | 1220 | 1365 | 1435 |
| H13 | 47 | R Bu | 7·5 | 860<br>(810) | 0·07 | 472<br>(350) | 0·04 | 1470<br>(690) | 0·11 | 1020 | 430 | 738 | 673 |
|  |  |  |  |  |  | *(b) Cows in sheds for 24 hours per day* |  |  |  |  |  |  |  |
| H 4 | 48 | R Bu | 6·2 | 3700<br>(3660) | 0·23 | 1780<br>(1610) | 0·11 | 2060<br>(1680) | 0·13 | 3800 | 1226 | 2420 | 2122 |
|  |  |  |  | *Cowshed only (cows brought in for milking twice per day)* |  |  |  |  |  |  |  |  |  |
| H 6 | 52 | Bu | 2·6 | 2740<br>(2470) | 0·07 | 2180<br>(1450) | 0·06 | 7190<br>(2080) | 0·19 | 4030 | 1812 | 2255 | 2281 |
| H 8 | 20 | Bu | 6·1 | 292<br>(257) | 0·02 | 315<br>(125) | 0·02 | 3085<br>(840) | 0·19 | 780 | 172 | 513 | 410 |
| H14 | 72 | Bu | 2·7 | 3620<br>(2930) | 0·09 | 2160<br>(1420) | 0·06 | 6410<br>(2080) | 0·18 | 4320 | 1654 | 2250 | 2209 |

B — Bulk collection of milk.
R — Cooling water re-used in drinking trough and for washing floors.
C — Cooling water discharged to drain.
C — No cooling water, or cooling water used in closed circuit.
Ho — Floors cleaned with water from pressure hose.
Bu — Floors cleaned with water from buckets.
• — Collecting pens washed.
* — Volume and strength estimated to be the same in the afternoon as the morning. No collection of dung.
† — 4·5 × Total nitrogen + 6·5 × N/8 permanganate value (this assumes that nitrite and nitrate are absent).
‡ — Values approximate only. Estimation was complicated by yard drainage from melting snow. Values represent increase in rate of flow and strength when parlour and dairy were washed.

## TABLE II

Results of analysis of urine and dung from full-grown Friesian cows

| | Urine | Dung | Slurry of urine and dung (3:4.66)* |
|---|---|---|---|
| Total solids (per cent) | | 13.8 | 9.8 |
| N/80 Permanganate value (ppm) | 4550 | 30,600 | 20,700 |
| (lb/cow/day) | 0.14 | 1.43 | 1.58 |
| N/8 Permanganate value (ppm) | 6370 | 39,600 | 24,140 |
| (lb/cow/day) | 0.19 | 1.84 | 1.84 |
| 5-day BOD (ppm) | 18,800 | 6500 | 12,240 |
| (lb/cow/day) | 0.56 | 0.30 | 0.94 |
| Organic carbon | | | |
| (ppm) | 17,500 | 42,800 | 33,800 |
| (lb/cow/day) | 0.53 | 2.00 | 2.59 |
| Total nitrogen | | | |
| (ppm) | 9900 | 3440 | 6460 |
| (lb/cow/day) | 0.30 | 0.16 | 0.49 |

*Assuming one cow produces 3 gals. of urine and 3/4 ft.$^3$ of dung per day.

## TABLE III

### Results of Analysis of a Sample of Pig Slurry

| | | |
|---|---|---|
| Volume | (gal/pig) | 2.2 |
| 5-day BOD | (ppm) | 25,500 |
| | (lb/pig/day) | 0.56 |
| N/80 Permanganate value | (ppm) | 4100 |
| | (lb/pig/day) | 0.09 |
| N/8 Permanganate value | (ppm) | 6295 |
| Organic carbon | (ppm) | 16,360 |
| Total nitrogen | (ppm) | 3512 |
| Total solids | (per cent) | 3 23 |
| McGowan strength | (pp.$10^5$) | 4672 |

## TABLE IV

Results of Analysis of Composite Samples of Crude Sewage, Settled Sewage, and Final Effluent at a Small Works Treating Domestic Sewage containing a High proportion of Farm Wastes by single filtration with recirculation

| | Crude* sewage | SettledΔ sewage (parts per million) | Final* effluent |
|---|---|---|---|
| 5-day BOD | 800 | 800 | 70 |
| | (400-2000) | (616-1000) | (36-100) |
| 4-h. permanganate value | 220 | 180 | 90 |
| | (74-640) | (174-222) | (69-101) |
| Suspended solidsΔΔ | 290 | 104 | 103 |
| | (69-664 | (80-148) | (78-149) |
| Ammoniacal nitrogen | 196 | 215 | 65 |
| | | (183-247) | |
| Oxidised nitrogen | 2 | 3 | 42 |
| Synthetic detergent as Manoxol OT | 13.5 | 16.8 | 5.0 |

*Composite of hourly samples 1300-1900 h. April 13, 1959, and 0800-1500 h April 14, 1959, mixed in proportion to flow

ΔComposite of hourly samples over 24-hour period April 13-14, 1959, mixed in proportion to flow

ΔΔHumus tanks had not been designed to take recirculated flow and were too small.

Recirculation ratio - about 1:1.

Hydraulic loading of filter - 25 gals. sewage/yd$^3$/day + recirculated effluent.

5-day BOD loading - 0.19 lb/yd$^3$/day.

Disease/Solid Waste
Abstracts

No. DSW-140

Author

Vladimir Madera, Vaclav Solin, Miroslav Spacek

Title (see 1 below)

The Removal of Wastes from Pharmaceutical Plants' Effluents

Reference

Public Health Engineering Abstracts, No. 1959

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 387 | | |

Abstract

Detailed experiments have been carried out to establish the quantity and composition of the wastes from pharmaceutical plants manufacturing chloramphenicol and lobeline. These wastes contain comparatively large quantities of organic matter: methanol, benzol, and ether as well as some byproducts and coproducts. The stench of the wastes is largely due to a small quantity of pyridine.

A proposal was put forward to separate the concentrated wastes directly at the manufacturing plant and to dispose of them by burning. To prevent corrosion, the wastes can be neutralized by limestone as the acidity is mainly due to hydrochloric acid. When limestone is used, intense quantities of carbon dioxide generate, which ensures excellent mixing. The neutralization lasts 1 hour, and as soon as the 2 layers form, they are separately filtered and conducted to the combustion chamber.

1 Sbornik VSCHT, Technologie vody (Scientific Papers From Institute of Chemical Technology, Prague, Technology of Water) 6, Part 1, 57-76 (1962).

Descriptors

wastes
pharmaceutical plants
chloramphenicol
lobeline
methanol
benzol
ether
pyridine
disposal
burning

No. DCW- 141

Author

C. Culpin

Title

Equipment for Disposal of Agricultural-Effluents

Reference

Chemistry and Industry, February 29, 1964, p. 350

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Abstract

Advances in methods of handling solid farmyard manure may make it preferable to convert liquid and semi-liquid manures to a more solid form in those parts of the country where plenty of straw is available. Solid manure has the advantage that it can be allowed to accumulate in a large heap, and can be stored until required for distribution. Some farmers who handle manure as a slurry from the piggery or poultry house to a small storage tank, pjmp it on to straw and later handle the dried-out product in the solid form. Similarly, a few farmers with slatted floor accommodation for cattle leave the slurry until it has dried out in summer, and then handle it by means of a hydraulic loader and a farmyard manure spreader.

When manures are handled in solid or semi-solid form, there is no doubt that there is appreciable loss of manurial value, especially nitrogen.

Average daily production of dung and urine by a dairy cow is about eight to ten gallons.

With pigs and poultry average amounts estimated in the N.A.A.S. investigation were 1.6 gallons per day per fatteningpig, and 6.2 gallons per day per 100 head of poultry

Descriptors

- equipment
- disposal
- agricultural effluents
- semi-liquid mixture
- slurry
- solid farmyard manure
- cattle
- pigs
- poultry
- silage effluents

Disease/Solid Waste
Abstracts

No. DSW-142

Author

W.R. Shirrefs

Title

Leicester's Compost Plant

Reference

Royal Soc. of Health J. Vol. 3, 173-177, 1965

Doc. No. Contract No. Date issued

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Abstract

The disposal of sludge, whether crude or digested, almost always presents a difficult problem. For some years the city has disposed of its refuse by controlled tipping, but recently sites suitable for this purpose have become more difficult to find. There is only a few months tipping left within the city boundary and future sites can only be found at some distance from the built-up area. whth a consequently increased cost of haulage.

The decision to compost sewage sludge and refuse was taken in 1962.

It was decided to proceed with the design of the plant on the basis of analyses of dried sludge and of refuse then produced in Leicester. The total amount of refuse was estimated from test weighings to be almost 100,000 tons a year, and the estimated production of sludge at Wanlip to be between 12,000 and 20,000 tons annually.

Lagoons were provided rather than the secondary digestion tanks originally included in the sewage works layout and form a suitable and cheap form of storage for the thickening of the digested sludge. In so doing they reduce the demand for chemical conditioning prior to filtering and they also form a useful buffer between the production of sludge from the works and its subsequent use in the manufacture of compost.

(See Tables I and II)

Dust extraction is by three large wet de-dusters, one to each hopper, which operate only whilst refuse is being tipped.

Waste gases produced during the fermenting period are extracted and passed through the dust extraction plant to the atmosphere.

(See Tables III, IV, and V)

There is some division of opinion as to whether the compost is suitable for immediate use on the land. The compost has a more important use as a soil conditioner, though it might conceivably be used also as a vehicle for the application of chemical fertilizers in some circumstances.

The annual tonnage of compost from the plant is estimated at 50 to 60,000 tons.

Descriptors

compost plant
disposal
sludge
refuse
value
capital cost
lagoons
quantitative analysis
waste gases
organic manures
composition

**Abstract (continued)**

## TABLE I

## Quantitative Analysis of Leicester Refuse

| *Classification* | *Controlled Tipping* | *Salvage Depot* |
|---|---|---|
| Collected | Tons | Tons |
| Bin refuse | 74,162 | — |
| Special refuse | 9,318 | 2,086 |
| Trade refuse | 2,254 | — |
| Delivered | | |
| Trade refuse | 8,694 | — |
| Totals 1961–62 | 94,428 | 2,086 |
| Compare totals 1960–61 | 95,482 | 2,235 |

*Analysis of Bin Refuse based on Seasonal Samples*

| | Tons | per cent |
|---|---|---|
| (a) Fine dust and cinder (under ¾in.) | 31,060 | 41·82 |
| (b) Cinder content (between ¾in. and 1½in. | 2,225 | 2·99 |
| (c) Vegetable and putrescible content | 11,050 | 14·93 |
| (d) Paper content | 13,450 | 18·15 |
| (e) Metal content (ferrous & non-ferrous) | 4,720 | 6·37 |
| (f) Rag content (including bagging and all textiles) | 1,572 | 2·12 |
| (g) Glass content (bottles, jars and cullet) | 4,755 | 6·42 |
| (h) Unclassified debris (not classified above) | 5,330 | 7·20 |
| TOTAL | 74,162 | 100·00 |

## TABLE II

## Analysis of Dried Leicester Sludge from Beaumont Leys

*The analysis of a mixture of crude sedimentation tank sludge, detritus sludge, stormwater tank sludge and humus sludge, is as follows:*

| | per cent |
|---|---|
| Volatile matter | 72 |
| Ash | 28 |
| Nitrogen | 3·4 |
| $P^2O^5$ | 1·75 |
| Ether Extract | 25·0 |
| Silica | 14·3 |
| Iron (as Fe) | 5·1 |
| Calcium (as Ca | 1·4 |
| Sulphate (as $SO^4$) | 2·4 |
| Tin | 0·1 |
| Lead | 0·18 |
| Aluminium | 1·9 |
| Copper | 0·03 |
| Chromium | 0·05 |
| Zinc | 0·20 |
| Manganese | 0·03 |
| Nickel | trace |
| Cobalt | trace |

**Abstract (continued)**

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## TABLE III

## Capacity of Composting Plant

*Refuse*

During 1961/62 87,820 tons of refuse was collected from 273,130 population.

With design figure of 300,000 population 96,600 tons will be collected.

Approximately 10,000 tons will be unsuitable for composting and therefore 86,600 tons will be delivered to the composting plant.

Average daily tonnage for five-day week = 333 tons.

Approximately 15 per cent will be removed for salvage before composting leaving 283 tons of refuse per day.

Due to seasonal variations in refuse quantity and water content it is estimated that:

Winter daily average = 312 tons at 25 per cent water content
Summer daily average = 254 tons at 30 per cent water content

*Sludge*

On the basis of 0·2 lb of dry sludge solids per head per day, the daily quantity of sludge after digestion and storage in lagoons is estimated to be 294 tons of sludge at 92 per cent water content for 300,000 population assuming a five-day machinery working week.

*Komline vacuum filters*

These filters will reduce the water content of the sludge to 78 per cent and a yield of 2 lb of dry sludge solids per sq. ft of filter area per hour has been used for the design. Chemical conditioning of the sludge with lime and aluminium chlorohydrate will be necessary prior to filtration.

The combined refuse and sludge water content should be 50 per cent for ideal composting conditions and in order to achieve this 185 tons of 92 per cent sludge will have to be dried each day to 67 tons of 78 per cent sludge.

The amount of sludge used at 92 per cent water content will vary according to the quantity and water content of the refuse but the daily average throughout the year will be [illegible]9 tons.

## TABLE IV

## Composition of Crude Organic Manures and Composts

*Some indication of the potential agricultural value of sewage sludge and domestic refuse and of composts manufactured from these may be obtained by comparing their contents of organic and mineral matter and major mineral nutrients—nitrogen, potassium and phosphorus—with the relevant figures for farmyard manure:*

| *Crude Wastes* | *As a per cent of total dry matter* | | | | |
|---|---|---|---|---|---|
| | *Mineral Matter* | *Organic Matter* | | $P_2O_5$ | $K_2O$ |
| Farmyard manure | 36 | 64 | 2·2 | 1·6 | 2·0 |
| Raw sludge | 49 | 51 | 2·4 | 1·3 | 0·3 |
| Digested sludge | 56 | 44 | 2·[illegible] | 2·2 | 0·[illegible] |
| Pulverized town refuse | 55 | 45 | 0·[illegible] | 0·62 | 0·43 |
| Fine dust from refuse | 76 | 24 | 0·[illegible] | 0·29 | — |
| Sewage sludge-refuse Composts | 50–55 | 45–50 | 0[illegible]·3 | 0·5–0·6 | 0·3–0·35 |

The above figures are taken from *Fertility from Town Wastes*, by J. C. Wylie, and the figures he gives for sewage sludge-refuse composts were determined from analyses of a number of samples prepared in Dumfriesshire. The figures in Table V were obtained from an analysis of the compost from the [illegible]no Composting plant at Radcliffe may be closer to those that will be obtained from Wanlip:

Abstract (continued)

## TABLE V

| | *per cent* | *per cent* |
|---|---|---|
| Mineral content | 62·27 | |
| Organic content | 37·73 | |
| | 100 | |
| Nitrogen | | 0·865 |
| Phosphorus | | 0·76 |
| Potassium | | 0·70 |
| Moisture content | 40 | |

Disease/Solid Waste
Abstracts

No. DSW- 143

Author

P. W. Kabler, S. L. Chang, N. A. Clarke, H.F.Cl

Title

Pathogenic Bacteria and Viruses in Water Supplie

Reference

University of Illinois Bulletin-Circular 81

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Bull 61(22):72-78 | 1963 | |

Abstract

Outbreaks of water-borne disease occur infrequently in the United States, although laboratory evidence indicates that most of the streams are contaminated with human and animal excreta. Pathogenic microorganisms probably do not multiply in natural waters, and disappear rapidly because of predators, lack of food, and other unfavorable environmental factors. Treated water supplies are increasingly infrequent sources of enteric disease because of improvements in water treatment processes, in sanitary control of water systems, and in procedures for the detection and enumeration of pollution indicators.

SUMMARY

1. Pathogenic bacteria of the Salmonella genus can be readily isolated from polluted surface waters.

2. Raw water sources may be contaminated with P. tularensis by infected animals.

3. Enteric viruses have been demonstrated in surface waters.

4. Pathogenic bacteria and viruses survive in water for a few days to several weeks, depending on the kind of microorganisms, characteristics of the water, predators, competitors, ambient temperature, etc.

5. Chemical flocculation, sedimentation, and filtration when properly applied remove 95 to 99.99 per cent or more of the bacterial and viral contents of the water.

6. Different types of enteric viruses vary widely in their resistance to free chlorine; poliovirus, Coxsackie, and some ECHO viruses seem to be more resistant than coliform or enteric pathogenic bacteria. The free chlorine residuals required for inactivation depend on pH, temperature, and contact time.

7. Combined chlorine is considerably less germicidal than free chlorine, and requires higher concentrations or longer contact periods to achieve comparable inactivation.

Descriptors

disease
epidemiology
treatment (water) (efficacy)
bacteria
viruses
water

Disease/Solid Waste
Abstracts

No. DSW-144

Author

Shu Yeh, M.D. Taiwan, China

Title

Relative Incidence of Skin Cancer in Chinese in Taiwan: with special reference to Arsenical Cancer

Reference

National Cancer Institute Monograph #10,

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Conference-Biology of Cutaneous Cancer, Phila., Penna., April 6-11, 1962.

Abstract

Skin cancer is not uncommon in Chinese in Taiwan, but the incidence is by no means as high as that reported for Chinese on the mainland. In a limited area on the southwest coast of Taiwan, a remarkably high percentage of chronic arsenical intoxication (owing to high concentration of arsenic in drinking water) has been observed in recent years. The pathology of arsenical melanosis, keratosis, and cancer is discussed and illustrated. In the same area an endemic peripheral vascular disorder resulting in gangrene of extremities, especially in the feet, has been noted. Clinically, its symptoms, signs, and course are similar to those of Buerger's disease.

52 cases of arsenical cancer are included in this series. All these patients are from a limited area on the southsest coast of Taiwan, with a population of approximately 160,000. In this area artesian wells as a source of drinking water have been used for 40 years. A majority of the artesian wells have a relatively high concentration of arsenic, ranging from 0.8 to 2.5 ppm. Among the inhabitants of this area a remarkable percentage of chronic arsenical intoxication, manifested as hyperpigmentation, keratosis, and cancer, was discovered in 1960.

Descriptors

cancer
arsenical cancer
pathology
melanosis
keratosis
peripheral vascular disorder
gangrene
artesian wells

Disease/Solid waste
Abstracts

No. DSW- 145

Author

P. H. McGauhey

Title

**Processing, Converting and Utilizing Solid Wastes**

Reference

Compost Science, Summer 1964, p. 8.

Doc. No. Contract No. Date issued

Abstract

Freedom to manage wastes by simple export from the city is now vastly constrained. What has happened to restrain the freedom of cities to export solid wastes? The answer lies in an understanding of the modern community and of the competing jurisdictions which seek unilateral solutions to waste problems.

Urbanization has progressed beyond the city limits to become a characteristic of rural areas as well.

City limits are extended to overwhelm rural enterprise with ruinous taxes. The farmer is faced with the choice of going out of business, to the disadvantage of the entire community, or finding some way to deal with wastes himself in order to resolve the environmental problems his activities create. Piling manures on the ground leads to odor and fly nuisances; burning tree trimmings and their agricultural wastes aggravates the air pollution problems. Burying wastes in the soil may increase crop diseases and insects, thus requiring more intensive use of stronger pesticides. These, in turn, increase the exposure of man to toxic materials in his food and water supply.

The normal fragmentation of governmental jurisdiction whether at the administrative, regulatory, operative, or investigative level, precludes an effective direct attack on a problem such as wastes management which involves simultaneously the urban, industrial, and rural sectors of the community and which has overtones in a variety of environmental control agenciesother than those whose primary interest is in solid wastes. Jurisdictions for environmental control exist at all levels of government. They include public health departments; water pollution control boards; air pollution control districts and boards; sanitation districts; fish and game commissions; park and recreation departments; agricultural agencies; and so on. Under their uncoordinated aegis, significant and highly important research projects have been directed to specific problems pertinent to solid wastes management.

Too few levels of society are concerned with the solid wastes problem, the

Descriptors

processing
converting
utilizing
Solid wastes
urbanization
rural enterprise
farmer
manures
fly nuisances
burning
composting
agricultural wastes
burying
crop diseases
insects
jurisdictions
government
research
public policy
planning
social goals
conversion plant
public attitudes
society
needed research
garbage
fermentation
shredding
refuse
wet digestion
salvage
aesthetic problems
economics
animal manures
sewage sludge
solid waste management

Abstract (continued)

tendency being to consider it a matter for resolution at the technical level. Research may now have to be directed beyond technical and economic considerations into areas of public policy, planning, and the social goals of our society.

The attitudes of citizens, engineers, public officials, private entrepreneurs, and other elements comprising the "public" contribute in an important manner to the creation of solid wastes problems and in inhibiting the development of logical systems for their solution. There exists a "swinish" thread in the character of even the most civilized of our citizens.

It might be said that any material becomes a "waste" whenever its owner or producer no longer considers it of sufficient value to retain. Any suggestion that he should thereupon invest more money in it, for the sale of disposal or any other financially unrewarding goal, is likely to be considered absurd, however inclined the citizen may be to object to polluted water, smog, rodents, odors, unsightly debris, and other conditions which result from his loss of interest in ownership.

Administrative officials of a community often mistake a policy of "no-spending-at-all" for the ideal goal of government, or find it more politically and socially rewarding to confine tax spending to more popular public works.

The inability of solid wastes to yield a high return on investment leads to a commercial disinterest in most problems posed by such wastes.

We must turn our attention to the needed research.

Some of the earliest instances of wastes processing have generally disappeared for reasons other than a lack of economical techniques. A prime example is the cooking of garbage for swine feeding. Research produced some quite efficient cooking and handling equipment. Increasing standards of environmental sanitation and aesthetics reflected in zoning ordinances confronted the hog raiser with the old question of going somewhere "beyond".

A similar fate befell the rendering of garbage for reclamation of grease and theproduction of tankage.

Fermentation as a method of disposal of solid cannery wastes scarcely got past the idea stage. The existence of cheaper ways to produce industrial alcohol, removed fermentation from the list of imaginative and economical possibilities to which research might be directed.

Shredding of municipal refuse for composting is a process which is not yet totally satisfactory.

The most overwhelming problems concern the technical difficulty of collecting the waste, and theproblemsof nitrogen robbing, and of insect and plant disease reservoirs which shredding to soil may create.

One problem which has thus far defied solution arises with the solid wastes produced in urban renewal projects and freeway right-of-way clearance.

Processing of cannery wastes by methods other than fermentation is currently the subject of research.

Technical research on wastes conversion by composting has long since progressed beyond the stage of delineation of fundamentals. There is little need for research into the composting process until utilization of the product, possibly as a result of research in that field, gives rise to the opportunity for process development.

Research to establish the engineering parameters and economics of wet digestion would seem worthy of support.

Abstract (continued)

As in the case of Processing and Converting of wastes, theproblems associated with utilizing the product have been considered largely in relation to each waste as a separate entity. A review of the factors involved in the utilization of several wastes may reveal hopeful avenues of research in processing and converting as well as in utilizing wastes.

Research can do but little to answer such problems individually.

From the standpoint of the municipality a careful study of the operating space, storage space, aesthetic problems, and salvage methods required in connection with any proposed method of refuse processing would provide important information needed in considering the cost and appropriateness of alternate methods.

Although research on ways to carry out a known process within the confines of an economical conversion plant still may be productive, the problem of utilizing compost remains a major roadblock to its adoption.

The first problem area concerns who is to produce the compost.

A secondproblem area concerns who is to utilize compost.

The Public Health Service demonstrated at Phoenix, Arizona the feasibility of composting to reduce volume of material. In the aggregate the results have been inadequate to launch composting on an important scale in the practice of municipal refuse management.

Unfortunately, it is difficult to find research avenues by which to approach the problems of utilization of compost on which adoption of the process depends. The need is to create a desire for organic humus on the part of agriculturists, establish an economical installation to produce compost, make suitable contractual relationships between public and private groups, develop an economical and practical method of applying compost to land.

Research on animal manures has been largely directed to processing for the purpose of removing its nuisance and fly breeding potential, rather than to its utilization. Farmers are no longer interested in its utilization. Nevertheless if animal manures are to be utilized it must be in commercial agriculture. Dr. Sam A. Hart has shown that the home owner and small specialty-user market is already saturated.(9)

There are several problems in the utilization of sewage sludge. As with animal manures and compost there is no agricultural demand for it.

a) If sold to the home owner, sludge must be heat-sterilized to protect the health of people who come in contact with it.

Processing, Converting, and Utilizing are not by themselves the most fruitful areas to which research of the technical project type can be directed. Research in these areas of solid wastes management has customarily been applied to various wastes separately. No new refuse disposal methods have emerged.

In the absence of utilization as a strong motive in wastes management, research on processing and converting of wastes has proceeded in a partial vacuum. It has reached the point where we are tooled up to do something that nobody wants done. Research on problems particularly directed to the utilization of individual wastes, particularly municipal refuse seems to have subsided to a state of lethargy.

To the author it seems evident that the concept of solid wastes management by each of the several jurisdictions that have responsibility within the overall urban-industrial-suburban-rural community is obsolete and such obsolescence is

## Abstract (continued)

being reflected in an impasse in research and development. The prospect of processing wastes on an area-wide or total-community basis opens up new avenues for research directed to utilization. Further research along the following lines suggested by APWA (7) in 1962:

1. Development of new processes for salvage.
2. Determining new uses for fractions of existing wastes.
3. Development of on-site processing of various waste materials, e.g., packaging, composting, etc.
4. Potential market value of compost.

The major problems yet to be overcome lie in the areas of public attitudes, equipment and processing plant development, and economics of systems. Studies of the technical feasibility and engineering parameters in solid wastes conversion by wet digestion and algal ponds, whole matter of management of solid wastes from the construction industry, restudies of processes for conversion of wastes in the light of a new range and variety of raw materials to be processed, are worthy of research.

The studies which appear most urgent at the present time are those which deal with people and public institutions. Wastes management problems should be studied on a community-wide basis with regard to their overall environmental effect on man's physical and mental health; ways sought to bring the co-ordinated efforts of engineers, health officials, planners, public administrators, legislators, etc. to bear upon the resolution of wastes problems.

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(7) Solid Wastes Research Needs. APWA Research Foundation Project No. 113, Spec. Report No. 24, May 1962.

(9) Hart, S. A. and P. H. McGauhey., "Wastes management in the food producing and processing industries." Paper presented at 11th Pacific Northwest Industrial Waste Conference, Corvallis, Oregon, May 8-10, 1963.

Disease/Solid Waste
Abstracts

No. DSW- 146

Author

Dr. Fritz Caspari, Wilhelmsfeld, Germany

Title

Capillary Drying of Mixtures of City Refuse and Sewage Sludge

Reference

Compost Science, Summer 1964, p. 21

Doc. No. Contract No. Date issued

Abstract

There have been in existence for many years proven methods for the purification of sewage, although little attention has been paid to the residue of the process, the so-called sewage sludge.

The usefulness of the sewage sludge in the biological circuit has been insufficiently investigated. When considering methods for increasing soil fertility, the city refuse and the sewage sludge should, from a biological standpoint, be brought together.

The new process is quite simple, Its first requirements are a sludge dewatering filter and an apparatus for shredding the city refuse in such a way that its capillary nature is not destroyed. The machine leaves behind a certain amount of untreatable rejects, which however does not exceed 10-15% of the total weight.

The reduced refuse, corresponding to 70-75% of the raw refuse, is the first of the two contributing factors of the process. Its moisture content is approximately 45%.

The filter reduced the moisture content of the sludge from 90% to 70% or less. The two products, i.e., the reduced refuse and the partly dewatered sludge were then mixed together mechanically.

The mixture of reduced refuse and sewage sludge is compressed into briquettes. The fermentable particles of the refuse and of the sludge are compressed up to 1/2-1/3 of the original volume.

While in the drying room, the briquettes undergo a remarkable reaction. There is a speedy rise in temperature up to 70°C, which during the drying time destroys any existing pathogenic bacteria and worm-eggs without creating any bad odors.

Throughout the whole process of drying and decontamination, the briquettes did not change any morein volume; due to the loss of moisture the briquettes become lighter and more porous. The dried briquettes conserve all the substances of potential biological value.

The briquettes can either be chopped up dry or be decomposed wet and be used as soil conditioner.

The capillary structure enables the mixture of refuse and sludge to be composted

Descriptors

capillary drying
refuse
sewage sludge
municipal waste utilization
filter
shredding

aerobically without the usual turning over process.

Should the material accumulate it can, if need be, be incinerated having a high calorific value of 1,700-2,000 kal,kg.

Disease/Solid Waste
Abstracts

No. DSW-147

Author

Lyle C. Randles, Jr.

Title

The Field of Refuse Salvage

Reference

Compost Science, Summer, 1963, p. 5

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Abstract

In Metropolitan Los Angeles, prior to 1957, the householders placed their garbage in one container, the noncombustible rubbish in another, and their combustible rubbish in the backyard incinerator. The ashes resulting from the incineration of the combustible rubbish were mixed with the noncumbustibles which like the garbage, was picked up in separate trucks by municipal or private collectors. The garbage was sold to hog feeders and the noncombustible rubbish and ashes were disposed of through the salvage industry. So, for nearly a half century, Los Angeles's rubbish was used - not wasted. In 1957, however, the Air Pollution Control District banned the use of the backyard incinerators and the Los Angeles area joined the nation in a search for adequate disposal sites.

The current trend, however, is to combine garbage and combustible rubbish.

Residential garbage production has been decreasing steadily since World War II. This decrease has been brought about by the introduction of frozen foods. The home garbage grinder has had an even greater effect in reducing the quantity of garbage collected and will, in time, play a more prominent role.

When garbage is produced in large quantities in restaurants, hotels, and institutions, its value has often justified direct collection by hog feeders.

One innovation is the dehydration and digestion of garbage for commercial use.

A conservative estimate is that over 2,500,000 dead animals (representing 3,000 tons) were picked up in the entire metropolitan area. Final disposition of the animals is through local rendering plants for conversion to high quality commercial fertilizer or poultry feed.

Compost is a soil conditioner or humus. It has the same general charcteristics as peat moss.

Waste paper, when being made into a new paper commodity, is first pulped by centrifugal agitation so that it becomes a semi-liquid, the liquid generally being water and chemicals The peper stock should, at the completion of agitation, washing, etc., be clean and sanitary, but the Pure Food & Drug laws have prohibited

Descriptors

water recovery
refuse
salvage
waste utilization
constituents
garbage
dead animals
compost

paper
wool
rags
wood
nonferrous metals
noncombustible rubbish
transportation
land fill

the use of remanufactured paper where it may come in direct contact with food. The net result - a very large market for reprocessed waste paper is lost.

Another example of federal legislation which has affected the salvage program in the United States is the Wool Products Labeling Act of 1939. This Act prohibits the sale of reclaimed wool without proper labeling of the items manufactured. Here again is a common public relations problem. Mrs. America is not receptive to purchasing a new Cashmere coat that carries a label which reads "This garment is made of 60% virgin wool and 40% reprocessed wool," but the same Mrs. America will go to Italy and buy a high style coat, suit or dress made of very fine wool which bears no label other than the name of the manufacturer. More than 60% of these garments consist of American reprocessed wool.

Most of our rags are shipped to Japan where sheap labor, low manufacturing costs and the obvious lower standards of living allow them to wash and reclaim the rags, process them by grade, then sell the finished product back to us.

Wood is another costly item of disposal in most large metropoligan areas because of the high cost of dump space. To the best of my knowledge, the conservation of used lumber and wood has not been thoroughly studied.

There are three definite classifications of scrap metals. First, there are nonferrous metals, which include copper, brass, aluminum, zinc, nickel, Monel, lead and tin. The most widely used product is copper. The salvage of this material is, as in the case of almost all nonferrous metals, relatively complete. The majority of rubbish collectors salvage nonferrous metals from household refuse because of the high return.

The second classification is cast iron.

The third generation classification of scrap metals includes all types of steel scrap. In our metropolitan centers practically all of the steel scrap generated in actually salvaged and reused; however, there are areas too far from the market to economically justify the shipment of the steel scrap to mills.

With the development of electrolytic tin plate during World War II, the quantity of tin on the average can was drastically reduced; therefore, tin recovery from used cans was no longer profitable. The only market for salvaged tin cans is the mining industry, where they are used in the precipitation of copper.

Today the industry consumes approximately 150,000 tons of processed cans annually.

QUANTITIES OF REFUSE
PRODUCED AND COLLECTED
IN THE COUNTY SANITATION
DISTRICTS OF LOS ANGELES COUNTY

| Refuse Classification | Average Quantity Produced Lbs. Per Capita Per Calendar Day | |
|---|---|---|
| Garbage | Residential | 0.55 |
| | Commercial | 0.12 |
| | | 0.67 |
| Combustible Rubbish | Residential | 2.25 |
| | Commercial | 0.25 |
| | | 2.50 |

Abstract (continued)

| | | |
|---|---|---|
| Noncombustible Rubbish | Residential plus Commercial | 0.55 |

## COMPOSITION OF COMBUSTIBLE RUBBISH COLLECTED

| | Per cent by weight |
|---|---|
| Paper-newspaper, wrapping, paper containers, etc. | 25.2 |
| Cardboard-salvable fibreboard | 5.0 |
| Rags-all cloth regardless of size or value | 1.0 |
| Small vegetation-such as grass and leaves | 21.7 |
| Large vegetation-such as tree and brush clippings | 42.4 |
| Wood-lumber scraps of all sizes and shapes | 1.9 |
| Leather and rubber-shoes, belts, tires, etc. | 0.8 |
| Synthetics-plastics, bakelite, etc. | 0.5 |
| Garbage-highly putrescible food wastes which should not have been mixed with combustibles | 0.5 |
| Noncombustibles-cans, bottles, metal scraps which should not have been mixed with combustibles | 1.0 |
| | 100.0% |

Average moisture content of above samples-about 45%

## COMPOSITION OF NONCOMBUSTIBLE RUBBISH COLLECTED

| | |
|---|---|
| "Tin" cans | 35.0 |
| Other metals | 10.0 |
| Glass | 15.0 |
| Rubber | 2.0 |
| Moisture | 3 0 |
| Other (includes organic matter, sod, plastics, rock, etc.) | 35.0 |
| | 100.0% |

Disease/Solid Waste
Abstracts

No. DSW-148

Author

Title

Municipal Incineration of Refuse: Foreward and Introduction (Progress Report of the Committee on Municipal Refuse Practices)

Reference

Jrl. of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 90, No. SA3, June, 1964., No. 3942

Doc. No. Contract No. Date issued

Abstract

The disposal of municipal solid wastes in the large community (100,000 population or more) has progressively favored incineration.

Over 125 million tons (approximately one billion cu yd) of solid wastes (refuse) are produced each year in the United States. Less than 20% of this refuse is disposed of by approved, nuisance-free methods; the remainder is handled with scant regard to sanitation or health hazards.

Disposal methods range from the now (1964) discredited dumping at sea and indiscriminate dumping on land to the methods used in varying degrees, such as reduction, piggeries, grinding, domestic incineration, composting, sanitary landfilling, and municipal central incineration.

Dumping on Land - These areas become insect and rat infested. They generate health hazards and depress real estate values

Piggeries - Under this system, garbage and seill, approximately 10% of the total refuse output, is collected separately and trucked to a hog farm. Inherent dangers are trichinosis and the decimating hog diseases

It should be noted that this method is applicable to only approximately 10% to 15% of the total refuse output and necessitates separate, costly collections. Nationwide surveys made in 1955 showed that approximately 100 municipalities still used piggeries for disposing of approximately 10,000 tons of food wastes daily.

Grinding - Its outstanding virtue is the immediacy of disposal of highly putrescible materials. In terms of sanitation and health, this method of disposing of garbage is excellent.

Cities with severe air pollution problems, like Los Angeles, have outlawed the use of on-site incinerators. Conversely, other cities, like New York, have mandated their installation and use in all dwellings housing more than four families. Domestic incinerators can be of substantial benefit inasmuch as they are able to reduce the municipalities collection and disposal load by approximately 70% On the other hand, their occasionally faulty and usually inadequate designs and improper operations can create health hazards and physical losses that may

Descriptors

incineration
health hazards
refuse disposal
depositing into water
dumping on land
real estate values
reduction
piggeries
trichinosis
hog cholera
vesicular exanthema
shredders
comminutors
cost
composting
dumping
plant capacity
municipal central incineration
construction costs
operating costs
research needs
grinding
landfill

outweigh these economies.

The nonmechanical windrow type composting requires from 8 acres to 10 acres of land per 100,000 population. Because the noncompostables are finally segregated, this type produces approximately one-half tone of compost for every ton of refuse processed. Mechanical, controlled types require little land. In this process, the noncompostables are ground up, thereby enriching the soil and eliminating any further disposal problems. Approximately three-quarter ton of compost are produced from each tone of refuse.

Some composting plants process mixtures of partially sorted refuse and sewage sludge.

Dumping on level lands requires pre-excavation of suitable trenches and pits. Dumping on marshy or tidal lands requires special attention to drainage problems, mud wave action, and safeguards against sinking of equipment. Dumping into quarries or ponds must provide against the pollution of trapped waters either by predewatering or by limiting dumping into water to the winter. In all cases, special care must be taken to guard against the pollution of water supply aquifers.

Sanitary landfills generally convert previously nonusable, nuisance-causing lands to useful, nuisance-free areas suitable for park and building development.

It should be emphasized that this is the only method able to dispose of all solid wastes irrespective of size, moisture, or other characteristics. All other methods are either limited as to type of materials that they can handle, or they leave end residuals, varying from 10% to 50% by volume of the original material, that inevitably must be deposited in landfills.

Municipal Central Incineration - Central incinerators are power plant-like structures designed to burn refuse under controlled, nuisance-free conditions at relatively high temperatures for the purpose of reducing the combustible components to an inert, organic-free residue that can then be readily disposed of by landfilling.

Disposal of refuse by incineration is characteristically prompt, thorough, and complete. The health hazards, odors, and other nuisances are either totally destroyed or largely alleviated by the high temperature burning. The refuse is reduced to a relatively innocuous residue of a chemically stable, odorless character. The ability of incinerators to process all but the most bulky solid wastes is matched only by the sanitary fill method.

The major disadvantages of incineration are the higher initial costs of construction; generally higher costs of operation and maintenance; greater skills required for efficient, nuisance-free operation; and finally the need for secondary disposal of the residue, approximately 20% to 25% by weight of mixed refuse, by landfilling.

In essence, the modern central incinerator is in the forefront of the most dependable and economic disposal methods for the large community.

Daily and Seasonal Variations in Refuse Output-These will range from 85% to 115% of the median.

No. DSW- 149

Author
Frank D. Masch. University of Texas, Austin, Texas

Title
Mixing and Dispersion of Wastes by Wind and
Wave Action

Reference
Int. J. Air Wat. Poll. 1963.

Doc. No. Contract No. Date issued
Vol. 7, pp. 697-720

Abstract

One of the principal objectives of waste disposal through ocean outfalls is to dilute the sewage, sludge or other waste by allowing it to mix and disperse in the surrounding sea water. From the standpoint of public health, the degree of mixing or the dilution must be adequate to reduce bacterial concentrations to safe non-injurious levels. From the aesthetic point of view, dilution should also be sufficiently thorough to eliminate any unsightly appearance of the waste near beaches or other areas subject to public usage. Since both practical and economical considerations require that the point of the waste release be as near to shore as possible, an understanding of the mixing process under various oceanic conditions is necessary to establish functional design criteria.

Mixing and dispersion of waste material in the ocean depends on two general aspects. The first part of the problem is concerned with initial mixing of the waste in the immediate proximity of the discharge point.

The second aspect of the dispersion problem is the disposition of the initially mixed waste sea water mass by such oceanographic influences as tidal currents, currents related to waves, currents associated with density gradients, currents induced by wind and turbulent wave motion. The effect of wind and wave action on both horizontal and vertical dispersion is the principal objective of the laboratory investigation described.

## SUMMARY

It is generally recognized that laboratory investigations are subject to certain restrictions particularly with regards to size or scale effects Thus it can be said that all the conclusions arrived at during the course of this study need prototype verification. However, laboratory results appear to justify the following conclusions

In every test run, the lateral diffusion coefficient was constant, and there was no evidence of the diffusion coefficient following a 4/3 relation. The lateral

Descriptors

mixing
dispersion
wastes
wind
wave action
waste disposal
ocean outfalls
sewage
sludge

diffusion coefficient which was independent of the water depth was related to the wave age and wind speed by Equation (20). For the range of test conditions, the lateral diffusion coefficient increased with increasing wave age. Assuming that the lateral mixing was controlled by wave action alone, a mixing length was written in terms of the orbital motion of the particles within the wave.

Observations on vertical mixing showed that vertical dispersion resulted from both the turbulent shear flow and the wave action. The vertical dispersion patterns at various stations downwind of a source could be approximated by one-half a normal error curve and the thickness of the vertical mixing layer defined in terms of a standard deviation. For the various wind speeds and water depths, the thickness of this mixing layer appeared to be constant. Although the relative amount of vertical transport due to wave action is unknown, the thickness of this mixing layer seems to be controlled by the waves rather than the water depth. A possible explanation for this wave mixing effect is discussed briefly.

Disease/Solid Waste
Abstracts

No. DSW-150

Author

W. T. Garrison, Otis F. Gay, M.D., & M DeVon Bogue

Title

A New Approach to Rural Refuse Collection

Reference

Public Works for June, 1964, pp 121

Doc. No. Contract No. Date issued

Abstract

Within Madison County, Alabama, until the development of the rural refuse collection service, no workable provision had been made for collection of refuse.

The need for improved refuse storage and collection was evident. For example, the ditches and banks of rural roads and highways were being covered with bags of refuse tossed from automobiles by people on the way to work. All roadside areas, woodlands and ditches contained large accumulations of refuse. The refuse was not only unsightly but also supported packs of wild and semiwild dogs The refuse attracted rat populations and produced both flies and mosquitoes in the summer.

The key element in the county - wide refuse storage and collection system proposed, and now in operation, was the use of detachable bulk-storage refuse containers of either 6 or 8-cubic yard capacity. It was felt that anyone who would sack or box his refuse, put it into his automobile and throw it out of the window on the way to work would not object to placing the material in a suitable container if one were available in a convenient location. Therefore, the system called for containers of sufficient capacity and number to be placed at intersections or other locations along county roads and highways in each rural area.

Descriptors

dogs
rats
flies
mosquitoes
rural
refuse
collection

Disease/Solid Waste
Abstracts

No. DSW-151

Author

Joe O Ledbetter

Title

Air Pollution from Aerobic Waste Treatment

Reference

Water & Sewage Works, January 1964, pp 62

Doc. No. Contract No. Date issued

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Abstract

Air pollution should be defined as the addition of any substance whose presence diminishes the usefulness of that mixture of gases known as air. With this definition, the air pollution problems from aerobic waste treatment are many and diverse.

Aerosols are air suspensions of particulates usually less than 50 microns (approximately 1/500th in.) in size. The particulates emerge as mists or droplets that come out of the main body of liquid waste being treated by emerging bubbles or by mechanical spattering.(1) Under most atmospheric conditions, the droplets quickly evaporate, leaving the nuclei of solid wastes that were dissolved or suspended in the droplet. At best the nuclei are dusts that are added to the burden of pollutants in the air, but they may contain material that is hazardous to the health. Bacteria are often transported by aerosols from liquids, that pathogenic bacteria survive the waste treatment process, and that other irritating materials may be carried in this manner. That the risk of infection or disease caused or transmitted in this manner is small, is readily admitted.

Waste treatment units give off objectionable odors.

The mathyl mercaptans, methyl sulfides, and amines plus indoles and skatoles, rather than hydrogen sulfide, have been cited as the most common offenders at some 300 sewage treatment plants across the country.(5)

The kindest thing that can be said is that the unit gives a spicy or non-objectionable odor. Yet, many people do find the odor objectionable. The courts

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(1) Woodcock, A.H. "Bursting Bubbles and Air Pollution," Sewage and Industrial Wastes. 27:9, p 1189, Sept , 1955.

(5) Post, Micholas "Counteraction of Sewage Odors," Sewage and Industrial Wastes, 28:2, p 221. February, 1956

Descriptors

air pollution
aerobic waste treatment
aerosols
solid waste
health
odors
methyl mercaptans
methyl sulfides
indoles
skatoles
hydrogen sulfide
control
research

have held that each person is entitled to "a constant supply of fresh wholesome air." (6)

The future trend of air pollution control in aerobic waste treatment will probably be toward putting municipal incinerators at waste treatment plants in order to serve the multiple-function incineration of refuse, sludge, and odors.

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(6) Gray, A. W. "Legal Aspects of Air Pollution", Air Engineering, 4:3, p. 29, March, 1962.

Disease/Solid Waste
Abstracts

No. DSW-152

Author

RE. Siverly & HF. Schoof

Title

**Utilization of Various Production Media by Muscoid Flies in a Metropolitan Area. I. Adaptability of Different Flies for Infestation of Prevalent Media**

Reference

Ann. Entomol. Soc. America, July 1955

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 258 | | |

Abstract

**SUMMARY**

Results of a 12-month fly larval survey conducted at Phoenix, Arizona, in 1951-62 indicated that predominance of Musca domestica in naturally infested substrates Of the 10 species studied, larvae of M. domestica were recovered from more than 50 percent of the samples and from 19 of the 21 different classifications of media

Muscina spp., in common with M. domestica, were able to utilize all general categories of production media-excrement, garbage, and miscellaneous types of media. Sarcophaga, Stomoxys calcitrans, and Ophyra were more frequently recovered from excrement than from other substrates. Phaenicia sericata, Phaenicia pallescens, Calliphora, and Callitroga macellaria were not common in excrement samples but displayed a high incidence of occurrence in garbage.

Each of the six prevalent species was characterized by its own distincitve profile as regarded seasonal occurrence. M. domestica exhibited the highest rate of infestation of any of the species irrespective of season. The adaptations of the house fly to sustained year-round development, plus its versatility in utilization of different types of media, are contributing factors for its predominance in the Phoenix, Arizona, area.

Descriptors

excrement
garbage
miscellaneous types
metropolitan area
flies
infestation
media
source of flies

No. DSW- 153

Author

RE Siverly & HF. Schoof

Title Utilization of Various Production Media by Muscoid Flies in a Metropolitan Area II. Seasonal Influence on Degree and Extent of Fly Production.

Reference

Ann. Entomol. Soc. of Amer. Vol. 48, 1955

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 320 | | |

Abstract

## SUMMARY

Larval surveys at Phoenix, Arizona, for a 12-month period in 1951-52 indicate that fly breeding is sustained throughout the year. During the spring, summer, and fall seasons, an inverse relationship existed between the amounts of various media infested and the degrees of infestation Summer infestations were concentrated in those substrates of relatively high moisture content or were subject to a moist environment Winter conditions permitted imaginal development but the magnitude of fly production was inhibited by low temperatures

Assignment of values 1, 3, and 9 to light, moderate, and heavy infestations provides a "production index" whereby the degrees of fly infestation can be quantitatively compared during four seasons. The "production index" can also be used as an indication of the breeding potential of the individual substrates. Chicken and pig excrements, garbage, melons, and stock feed displayed the highest fly production potential.

Descriptors
flies
metropolitan area
seasonal influence
fly production

Disease/Solid Waste
Abstracts

No. DSW- 154

Author
Henry S. Fuller

Title
Veterinary and Medical Acarology

Reference
Ann. Rev. Entomology, 1956, pp 347

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Abstract

This review soncerns ticks and mites of known veterinary or medical importance The tissues of many parasitic Acarina satisfy basic requirements for a wide variety of pathogenic microorganisms, including certain viruses, rickettsiae, bacteria, spirochetes, protozoa, and helminths, one must deal with a similarly wide variety of problems in microbiology.

During at least one stage in their life cycle, all ticks and certain mites are parasitic on or in terrestrial vertebrates Since some of these parasitic forms attack human beings or domestic animals, they may act as sirect causative agents of disease, or they may transmit pathogenic microorganisms. Certain parasitic species, not known to attach man or domestic animals, may play roles in the biological survival mechanisms of important pathogens by transmitting them among suitable wild hosts and by acting as reservoirs of infection.

As a result of their important role as biological vectors of relapsing fever, *Ornithodoros* ticks probably deserve most emphasis.

The complexity of the problem of these ticks as vectors of relapsing fever is illustrated by the following facts: (a) the various "species" of *Borrelia* cannot be separated on the basis of morphology or tinctorial properties; (b) they have not been found to multiply in acellular media; however, they multiply within developing chick embryos; and (c) adequate criteria for species separation, based on the biological characteristics of *Borrelia* spp., have not been firmly established.

The classical observations of Davis (17) showed the existence of specific relationships between O. *turicata*, O. *hermsi*, and O. *parkeri*, and their respective spirochetes. For example, O. *turicata* was able to transmit only its own spirochete and was unable to transmit spirochetes derived from the other two species of tick; similar specificity was observed for O. *hermsi* and O. *parkeri*.

The interepidemic reservoirs of the relapsing fevers pose a question of epidemiologic importance which involves consideration of the fundamental biological survival mechanism of *Borrelia* species and of the roles played by

Descriptors

medical acarology
ticks
mites
parasitism
vertebrates
pathogenic microorganisms
spirochetes
protozoa
rabbit tick
dogs
Trombidiform mites
viruses
rickettsiae
helminths
reservoirs
vectors
family ixodidae:hard-bodied ticks
rocky mountain spotted fever
*dermacentor variabilis*
hosts
tick-borne hemorrhagic fevers
tick-borne encephalitides
mesostigmatic mites
rodent
insecticides
filariasis
cotton rats
murine typhus
chiggers
itch mite
*Sarcoptes scabiei*

Abstract (continued)

arthropods as hosts to the spirochetes. It is generally accepted that Ornithodoros ticks function as reservoirs as well as vectors of the respective Borrelia species which they transmit. With respect to louse-borne relapsing fever, however, it is obvious that lice are not the reservoir, and that lack of critical data makes it impossible to do more than speculate on the possible role of human beings as reservoirs of the spirochetes.

Family Ixodidae:Hard-bodied Ticks

This family comprises several genera containing species which may be natural hosts to one or more species of microorganisms, including viruses, rickettsiae, bacteria, and protozoa. The agent of tularemia has been recovered from an ever increasing number of species of ticks. A similar remark is perhaps applicable to the rickettsiae of Q fever; although ticks possibly function as reservoirs of the agent, and although they are good candidates for potential vectors, yet their actual importance in transmitting the agent to animals and to man remains to be demonstrated conclusively.

Strains of R. rickettsii recovered from rabbit ticks, Haemaphysalis leporis-palustris, collected in the western United States, produced only mild disease in guinea pigs; passage in D. andersoni of strains recovered from H. leporis-palustris did not enhance their virulence.

The ecology of Ricky Mountain spotted fever in the western United States differs in several important respects, especially tick species and and mammalian hosts, from that in the eastern part of the country.

The rabbit tick, Haemaphysalis leprosis-palustris, which apparently never bites man, may transmit mild strains among rabbits, but its relative importance in maintaining strains of the type usually recovered from human beings has not been established.

The main vector to man in the eastern states is Dermacentor variabilis. Dogs are frequent hosts for the adults.

Tick-borne hemorrhagic fevers

Crimean hemorrhagic fever is a rural disease with seasonal incidence, occurring sporadically in agricultural workers from April through September. In places where the disease occurs in man, the population of ticks reaches its peak in July, shortly before the peak in human cases occurs.

Omsk hemorrhagic fever, which occurs in the Barabe Steppe of the Omsk Oblast in Siberia, resembles the Crimean disease in its clinical and epidemiologic features. The tick vector is suspected to be Dermacentor pictus. The peak in seasonal activity of the ticks precedes the peak in human cases by an interval corresponding to the period of incubation in man, and D. pictus frequently bites man. A common wild rodent, Microtus gregalis, is a frequent host in nature of D. pictus and of the virus.

Tick-borne encephalitides

During recent years it has become increasingly apparent that a number of tick-borne neurotropic viruses of Europe, Russia, and northern Asia are very closely related, and perhaps indistinguishable. Ixodes ricinus apparently transmits virus meningo-encephalitis of man in Slovenia (43 , diphasic meningo-encephalitis in European Russia (44), and louping ill of sheep in various parts of Europe (5).

## Abstract (continued)

### Mesostigmatic Mites

There is no convincing no conclusive evidence of the importance of essentiality of bird mites as vectors of the viruses of western (WEE) or of eastern equine encephalomyelitis (EEE), or of St. Louis encephalitis (SLE).

The tropical rat mite, *Ornithonyssus bacoti*, has not yet been demonstrated to be an important naturel vector of human pathogens.

Studies of O. *bacoti* as an experimental vector of filariasis among cotton rats have been most fruitful.

Philip & Hughes (58) found that O. *bacoti* could serve as an experimental vector of rickettsialpox.

The behavior of O. *bacoti* and of related blood-sucking rat mites as hosts to the rickettsiae of murine typhus is a moot question.

*Allodermanyssus sanguineus*, a parasite of house mice, was demonstrated in 1946 as a vector of rickettsialpox to man.

### Trombidiform Mites

From the standpoint of disease transmission, chiggers (Family Trombiculidae) are probably the most important group of mites. Ceetain species are known to be vectors of scrub typhus.

The most important mite-borne disease of man is scrub typhus.

Concrete evidence suggesting the existence of a jungle cycle in scrub typhus was obtained by the pertinent observations of Traub et al. (82) in the primary jungle of Malaya. They recovered the causative rickettsiae from the tissues of rats belonging to three species which are found almost exclusively in primary jungle. Infection was also demonstrated in the chigger species *Euschongastia audyi* (identified at the time as E. *indica*) taken from three squirrels. These mammalian and acarine hosts of the rickettsiae in the jungle are different from the species which occur in inhabited areas and which are known to be associated with the disease in human beings.

### Oribated Mites

These mites are intermediate hosts of tapeworms. Among the more familar worms is *Moniezia expansa*. This cosmopolitan parasite of domestic ruminants may gain access to three mammals when they ingest certain free-living oribatid mites which are common in pastures and which sometimes harbor the worm in its cysticercoid stage.

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(17) Davis, G.E., Relapsing Fever in the Americas, 41-47 (American Association for the Advancement of Science, Publ. No. 18, Wash. D.C., 130 pp., 1942).

(5) Rivers, T.M., Ed , Viral and Rickettsial Infections in Man, 2nd ed. (J. B. Lippincott Co., Phila. Penna., London, Eng., Montreal, Cana., 886 pp. 1952)

(43) Bull. World Health Org., 12, 487-594 (1955).

(44) Smorodintsev, A.A. Ed., Neirovirusnye Infektsii (Medgiz-Moskva, Moscow, USSR, 328 pp. 1954)

(58) Philip, C B., & Hughes, L.E., Am. J. Trop. Med, 28, 697-705 (1948)

(82) Traub, R., Frick, L.P., and Diercks, F.H., Am. J. Hyg., 51, 269-73 (1950).

Disease/Solid Waste
Abstracts

No. DSW-155

Author

Chester W. Emmons

Title

Soil Reservoirs of Pathogenic Fungi

Reference

J. Wash. Acad. of Sci., Jan. 1962, pp. 3.

Doc. No. Contract No. Date issued

Abstract

Some of the antinomycetes produce chronic granulomatous diseases which resemble in certain respects the systemic mycoses. The species of Streptomyces and Nocardia which are the etiologic agents of these diseases grow in soil or compost.

Soil and humus rather than diseased man or animals are the reservoirs from which pathogenic species of Streptomyces and Nocardia enter the respiratory tract of the subcutaneous tissues of the patient. It is a fundamental concept in any consideration of the systemic and subcutaneous mycoses that, with very few exceptions, these mycoses are infectious but not contagious diseases, that they do not spread from man to man or animal to man, and that the fungi which cause them are normal components of the varied and complex microflora of the soil or of organic debris in the soil. Probably the human or animal host does not play an essential role even in reseeding soil. The pathogenic fungi, once established in a favorable environment, are capable of indefinite growth as saprophytes in suitable soil.

Typical strains of S. *schenckii* are isolated occasionally from sphagnum moss. mulching materials, and soil with which gardeners work.

*Histoplasma capsultam* finds an acceptable substratum and habitat in soil enriched by the excreta of the chicken.

The common brown house bat (*Eptesicus fuscus*) also can provide a suitable environment for the fungus.

Trees provide roosting sites for large numbers of starlings, and we believe the contamination of the soil by these birds provides the environmental conditions suitable for the growth of this pathogenic fungus.

Aspergillosis is a relatively rare disease in man, but it causes many deaths in chicks, turkey poults, wild geese, and quail.

A. *fumigatus* is thermophilic and it probably grows very commonly in compost piles. Leaves and branches of trees passed through "chippers" yield a type of coarse mulch that provides apparently optimum conditions for growth of A. *fumigatus*.

Man appears to have a very high natural resistance to aspergillosis. In

Descriptors

soil
fungi
mycology
bacteriology
actinomycetes
mycoses
streptomyces
nocardia
compost
sporotrichum schenckii
nocardia asteroids
coccidioides immitis

Abstract (continued)

fact, pulmonary aspergillosis is rare in normal persons and perhaps is usually secondary to tuberculosis, silicosis, or some other primary lung disease.

Cryptococcosis, caused by the yeast-like fungus Cryptococcus neoformans, is the most frequent fungal cause of meningitis. Pulmonary lesions are frequently seen, and it is assumed that the disease begins as a respiratory infection.

It was isolated from barnyard soil and was regularly present in old nests and droppings under roosting sites of pigeons.

Several outbreaks of pneumonitis in men exposed to old accumulations of pigeon excreta have been recorded in medical literature. The man were exposed to dust while cleaning or demolishing old buildings which had housed pigeons for many years.

The most convincing evidence against the diagnosis of histoplasmosis in these cases is that Histoplasma has never been isolated from pigeon dung on the upper floors of buildings. but we almost invariably find virulent strains of Cryptococcus neoformans in such accumulations.

The pigeon is not a host to the fungus. This is a saprophytic association in which the fungus grows in an unusual substratum which is inhospitable to other fungi.

According to "Vital Statistics of the United States", each of three of the mycoses (coccidioidomycosis, histoplasmosis, and cryptococcosis) kills 50 to 75 persons per year. The actual numbers of diagnosed and undiagnosed fatal cases may be many times these numbers.

Disease/Solid Waste
Abstracts

No. DSW-156

Author

William L. Jellison

Title

Fleas & Disease

Reference

Ann. Rev. Entomology, 1959 pp. 389

Doc. No.

Contract No.

Date issued

Abstract

Considerable host-parasite specificity is exhibited by both vector and parasite. An outstanding example of this degree of relationship is the relapsing-fever group of spirochetes of the genus Borrelia and their tick vectors of the genus Ornithodorcs. These spirochetes exhibit a high degree of vector specificity, are maintained in part through transovarial passage, and develop in the body cavity of the tick. Only a single species is not carried by ticks, i.e., Borrelia recurrentis (Lebert), the cause of louse-borne relapsing fever of man.

There seems to be no better way to refer to an arthropod-pathogen combination within such groups than as an "evolutionary vector of the respective pathogen", meaning that vectors and pathogens evolved from an ancestral vector-pathogen combination.

In regard to fleas, there are several instances in which they are well-adapted biologic vectors of a pathogen

There is no indication that characteristic strains of P. pestis are related to any special species. genera, or families of fleas. While the organism is dependent upon fleas for its perpetuation and transmission, it does not invade the tissue of the flea, does not pass an essential part of its life cycle in the flea, and is frequently deleterious to the flea. Fleas have not been shown to be important vectors of tularemia, and the causative organisms has definite biological vectors, mainly among the ixodid ticks.

Murine typhus is the only rickettsial disease associated with fleas. The organism of murine typhus is well adapted to flea transmission and multiplies intracellulary within the flea, where it is not noticeably harmful.

Some mammalian trypanosomes are a rather homogenous "lewisi group" and are carried by fleas.

One of the first important developments following identification and culture of Pasteurella pestis was the final establishment that rat plague and

Descriptors

fleas
disease
vector
Pasteurella tularensis
wild rodent populations
salmonellosis enteritidis
Rickettsia typhi

spirochetes
borrelia
Ornithodorcs
murine typhus
eqizootic
Ctenocephalides canis
enzootic infection

plague
Pasteurella pestis
tularemia
trypanosomes
sylvatic plague
Pulex irritans
dust
tapeworms

## Abstract (continued)

human plague were caused by the same organism. The relation of rat epizootics to human epidemics had been observed since antiquity, the rat epizootic usually preceding the human cases.

After plague appeared in Hong Kong and Canton in 1894, it spread rapidly to other coastal cities of the world. In 1899, there were at least three instances of plague on ships entering United States ports (67). It is not likely that plague became established in our ports from any of these ships. However, on March 6, 1900, plague was diagnosed in a Chinese resident in San Francisco. Sporadic cases occurred there throughout the summer and fall. The toll of plague in this first epidemic for San Francisco, ending in 1904 was recorded as 121 cases and 118 deaths.

Plague reappeared in San Francisco in 1907 and occurred in Seattle the same year, in New Orleans in 1912, in other Gulf Coast cities in 1920, and in Los Angeles in 1924. Vigorous rat- and flea-control measures have eliminated it from our cities insofar as can be determined, but plague still persists in wild rodent populations (sylvatic plague).

In 1908,...plague in North America was no longer confined to rats and rat fleas but had become established in ground squirrels, *Citellus beecheyi* (Richardson) in Contra Costa County, California,.... An unexpected development ... was the discovery of a new disease, tularemia, in Tulare County, California .... A systematic survey of rodents and rodent fleas for plague which was already in progress was greatly intensified... plague was found to be endemic in 14 western states and two Canadian provinces, Alberta and Saskatchewan. It was found in 38 species and subspecies of rodents and lagomorphs. The Sciuridae or squirrel family were most prominent carriers.... This type of plague has come to be known as sylvatic or campestral plague and is present in many parts of the world.

### Tularemia

*Pasteurella tularensis* (McCoy & Chapin), the etiologic agent of tularemia, has many vertebrate reservoirs and arthropod vectors in nature and other potential vectors that have been implicated by laboratory experiment only. Ticks are especially efficient vectors and often carry the bacterium to man.

Tularemia infection is very infrequently recovered when wild-rodent fleas are tested for plague at the San Francisco Laboratory.

There is very little or nothing in the epidemiology of tularemia in man to suggest that fleas are important vectors (37). However, human infection is not a good indicator of the role of fleas as vectors among wild rodents because wild-rodent fleas do not have the intimate contact with man or the predilection to bite him that rat fleas have. It is possible that fleas are more important in the spread of tularemia in rabbits and rodents than is now recognized, and the subject invites further investigation.

### Salmonellosis

The transmission of *Salmonella enteritidis* (Gaertner) by *Pulex irritans* (Linnaeus) and *Ctenocephalides canis* (Curtis) was studied by Varela & Olarte (119). They found that the pathogens survived in fleas up to 96 hours, but transmission by bite was not demonstrated.

In the course of laboratory investigations on plague, Eskey, Prince & Fuller (31) found that some of their fleas had become accidentally infected with S. *enteritidis*. They then demonstrated that X. *cheopis* and *Nosopsyllus fasciatus* (Bosc) could transmit the infection to mice. The exact mode of transmission was not determined, but regurgitation into the bite wound seemed probable. The same flea species were also infected with *Salmonella typhimurium* (Loeffler) but did not

## Abstract (continued)

### Murine Typhus

Fleas are generally accepted to be the vectors of murine typhus, also known as endemic typhus, flea-borne typhus, Mexican typhus (in part), and tabardillo. The causative organism of flea-borne typhus is *Rickettsia* (*Rickettsia*) *typhi* (Wolbach & Todd).

The evidence that fleas are the only vector or even the principal vector of the rickettsia of murine typhus is not conclusive, and the exact method of transmission has not been established. Transmission may be by flea or mite bite, by passage of infection through the skin where it has been abraded by scratching flea bites and contaminated by infected flea feces, by inhalation or ingestion of rickettsia-laden flea feces or rickettsia-laden rodent urine in the dust of buildings.

It is accepted that epidemic louse-borne typhus was prevalent in eastern North America at one time but probably died out before 1900.

After a careful epidemiologic study, Maxcy (77) postulated the necessity of a rodent reservoir and insect vector for typhus in the eastern states. It remained for Dyer, Rumreich & Badger (29) to make the first isolation of murine typhus from rat fleas collected at a typhus focus in Baltimore. They were also successful in experimental transmission of murine typhus from rat to rat with X *cheopis*.

Mooser, Castaneda & Zinsser (83) found that the rat louse was readily infected with murine typhus and transmitted the disease from rat to rat under simulated natural conditions. While it may be important, as they suggest, in maintaining enzootic infection, this louse does not bite man and would not be direct cause of human infection.

It is now accepted that rat fleas of several species play a prominent part as vectors of this disease.

As facts from nature, the hospital, and the laboratory become known regarding a widespread disease, its epidemiology increases in complexity until it is no longer safe to make any positive, unqualified statement about it. Perhaps the best we can say in summary is that endemic typhus is a distinct entity but closely related to, and possibly derived from or progenitor to, classical epidemic typhus (13). It is primarily a disease of murine rodents, which include only the introduced rats, genus *Rattus*, and mice, M. *musculus*, in North America. It is spread from rodent to rodent by their fleas, lice, and possibly mites, and occasionally to man from rats and mice, presumably by fleas. The most likely mode of infection is by organisms penetrating abraded skin at the site of flea bites contaminated by flea feces. Infection by direct bite remains a possibility, and infection by inhalation and ingestion is probable.

Murine typhus has practically disappeared from many large cities and has experienced a dramatic drop in incidence throughout the United States coincidental with vigorous control measures based on the premises outlined above.

### Trypanosomiasis

With the exception of T. *cruzi*, a species transmitted by Hemiptera, none of the rodent trypanosomes is known to be pathogenic for man.

### Cestode Infestations

The cysticercoid stages of several tapeworms develop in fleas. One is the common cat and dog parasite, *Dipylidium caninum* (Linnaeus). D. *caninum* is

## Abstract (continued)

of medical importance, as it occasionally infests children

Wardle & McLeod (124) also list the following fleas as intermediate hosts of rodent tapeworms; X. *cheopis*, C. *canis*, and P. *irritans* for *Hymenolepis nana* Siebold; *Nosopsyllus fasciatus* (Bosc), and X. *cheopis* for *Hymenolepis diminuta* Rudolphi. These two cestodes have many other insect hosts, especially bettles Although they are essentially rodent parasites, they frequently infest children.

### Dermatitis

Some idea of the importance of fleas as pests in the San Francisco Bay area is given by Lunsford (72) who in a paper entitled "Flea Problem in California" quotes the miserable experiences related by early travelers and newcomers.

Our work in public health must be guided by principles such as those expressed, respectively, by the surgeon general of the Public Health Service and by the World Health Organization Constitution (8): "Public health has become more then the absence of disease"; "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." Within these guide lines the pest flea and the pest mosquito must go, along with the plague flea and the malaria mosquito.

In addition to the more familiar pathogens which are transmitted by fleas as discussed previously, Steinhaus (113) lists a number of microorganisms that have been associated with fleas in nature or by experiment. Although some of these are potent human pathogens, e.g., the leprosy and glanders bacilli, subsequent experience has failed to show that their flea association is of any epidemiological significance.

Knowledge gained in the study of fleas and disease has soon been applied to practical control, and, although our information on some of these diseases is still incomplete, the diseases have been controlled.

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No. DSW-157

Author

Title Isolation of Colorado Tick Fever Virus from Rodents in Colorado

Reference

Science, 22 August 1958, pp. 413

| Doc. No. | Contract No. | Date issued |
|---|---|---|

Abstract

Although Colorado tick fever virus has been isolated frequently from man and from the Rocky Mountain wood tick, Dermacentor andersoni Stiles (1) spontaneous infection of wild mammals has not been previously reported. Species expected to harbor the virus must necessarily be hosts of the immature stages of D. andersoni, the only tick that has been incriminated in transmission of the disease to man. We have obtained serologic evidence suggesting the occurrence of natural infections in one such animal species, the Columbian ground squirrel, Citellus columbianus, in western Montana and have found this species to be readily susceptible to experimental infection. This report records the first isolations of virus from mammals in nature. The hosts were the golden-mantled ground squirrel, Citellus lateralis lateralis, and the porcupine, Erethizon dorsatum epixanthum, collected in western Colorado.

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Descriptors

tick feber
rodents
virus

Disease/Solid Waste
Abstracts

No. DSW- 158

Author

Jean J. Schueneman

Title

Air Pollution Problems & Control Programs

in the United States

Reference

J of Air Poll Con. Assoc., V. 13. No. 3,

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| P. 116, March 1963 | | |

Abstract

Solid Waste Disposal

The amount of refuse burned and the way in which it is burned have a considerable influence on air pollution problems. The amount of combustible waste produced per capita has increased to around 1000 pounds per year in 1960, from about 640 in 1930 (See figure 1). Burning of wastes from demolition of buildings has been increasing as has the burning of combustible parts of junk auto bodies, prior to re-use of the steel. No data are available on quantities burned but it is known that around 4,000,000 automobiles are scrapped each year.

Burning dumps cause air pollution problems in about 25% of the urban communities of the country, according to data collected in state-wide air pollution surveys. They are the most frequently reported cause for localized air pollution problems. About two-thirds of all cities employ open dumps to dispose of refuse, the proportion being higher in smaller cities and lower in larger cities. Open burning of refuse on domestic, commercial, and industrial premises causes problems in many areas. In Detroit, for example, in 1961, nearly 40% of all public complaints about air pollution involved open fires. Policing and adjudicating these problems consumes a lot of the control agencies resources.

Incineration of refuse on domestic premises is permitted in some cities and encouraged in a few (using "approved" incinerators) even though it has been shown that in urban areas, this procedure is usually more expensive than municipal collection and disposal and, in all probability, will result in difficulties from an air pollution control viewpoint.

Open burning of refuse on the premises where produced and at dumps is a needless source of pollution. Much time and effort on the part of the envorcement agency could be saved if this practice could be eliminated, to say nothing of the reduction of air pollution that could be achieved and other problems that could be avoided. All possible action should, of course, be taken to work toward elimination of open burning of refuse.

Descriptors

air pollution
solid waste disposal
burning of wastes
dumps
combustible waste

Disease/Solid Waste
Abstracts

No. DSW-159

Author J. D. Trask, M.D., J. R. Paul, M.D. &
J. L. Melnick, Ph.D.

Title The Detection of Poliomyelitis Virus in
Flies Collected During Epidemics of Poliomyeliti

Reference

J. of Experimental Medicine, V. 77, 1943

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| p. 531 | | |

Abstract

SUMMARY

1. A series of 19 different samples of flies collected within epidemic areas during and after the onset of nearby human cases of poliomyelitis have been tested for the virus of poliomyelitis. Four of these samples proved positive.

2. Methods used in collecting the flies, preparing the inocula, and examining the inoculated monkeys (and other animals) are described.

3 All of the positive tests were obtained by the intranasal and intro-abdominal inoculation of Java (cynomolgus) monkeys. Green African and rhesus monkeys represented the smaller number of other monkeys used in which only negative results were obtained.

4. All of the positive samples (as well as nearly all the negative ones) contained "blow flies," and green bottle flies.

Descriptors

poliomyelitis virus
flies
epidemics

Disease/Solid Waste
Abstracts

No. DSW-160

Author W. McD. Hammon, H W Lundy, J.A. Gray, F.C. Evans, F. Bang & E. M. Izumi

Title A Large-scale Serum-Neutralization Survey of Certain Vertebrates as Part of an Epidemiological Study of Encephalitis of the Western Equine and St. Louis Types

Reference

J. Immunology, V. 44, 1942, p. 75

Doc. No. Contract No. Date issued

Abstract

Studies of summer encepalitis made in the Yakima Valley, Washington in 1940 (Hammon(1) and Hammon & Howitt(2)) indicated that this area offered an unusual opportunity for epidemiological research of a broad biological nature. In 1939 there had occurred a severe epizootic of horse encephalomyelitis involving from 500 to 600 animals and associated with about 35 human cases. In 1949, 86 human cases were reported (57 confirmed by autopsy or neutralization-tests) while there were only about 50 horses known to have been affected. The blood of several chickens, ducks, turkeys, pheasants and horses were found to contain antibodies against either the western equine, the St. Louis virus or both.

SUMMARY

1. From an irrigated western valley region, where both St. Louis and western equine encephalitis occur in annual epidemics, 576 sera representing 74 species were examined by means of the neutralization-test for antibody against both viruses.

2. Each of the viruses was neutralized by approximately 50 percent of the sera from domestic fowl and to a less extent by sera from domestic mammals The sera from wild species from each group showed a significantly lower percentage of positives than those from the respective domestic groups. Only 8 percent of the sera from wild mammals possessed antibodies No sampling error was found which would alter the significance of these differences

3. From "control" areas, where encephalitis was not recognized, 132 sera, largely from domestic species, were tested. Only one was positive. This confirms the specificity of the neutralization-test.

4. In this valley the epidemiology of these two diseases appear to be parallel.

5. It is concluded that many of these birds and mammals, principally the domestic fowl, probably serve as reservoirs for infection of mosquitoes. The percentage of susceptible horses which become infected is very high

Descriptors

survey
vertebrates
epidemiological study
encephalitis
western equine & St. Louis types

No. DSW-161

Author

M. Dorthy Beck

Title

California Field and Laboratory Studies on Relapsing Fever

Reference

J. Infect. Disease, V. 60, 1937, p. 64

Doc. No. Contract No. Date issued

Abstract

SUMMARY

Relapsing fever is endemic in California. One hundred and six cases have been reported from 1921 through 1935 There are nine foci of infection in the mountanous districts over 5,000 feet in elevation; the important ones being Big Bear Lake, Lake Tahoe and Packer Lake.

Thirteen strains of spirochetes resembling T. recurrentis were isolated from rodents in the field. Only shipmunks and Tamarack squirrels (Sierra chickaree) were found to harbor spirochetes in the districts surveyed.

Long periods of latency in mice are demonstrable up to one hundred and fourteen days.

The spirochetes of both human and animal origin show remarkable resistance to freezing, to shipping uniced in the clot and in the tissues, and to remaining viable in defibrinated sheep blood for at least 195 days.

Hyperimmune guinea pig serums have been produced from shipmunk and Tamarack squirrel (Sierra chickaree) strains of spirochetes. Protectin was obtained with homologous and heterologous rodent strains and in one instance protection was demonstrated with antiserum produced from a rodent strain against inoculation with a human strain of spirochetes.

The rodent and human strains were found to be identical in morphology and similar in susceptibility to laboratory animals. These strains are undoubtedly the same since the rodent strains are directly transmissible to man.

Descriptors

spirochetes
T. recurrentis
chipmunk
Tamarack squirrel (Sierra chickaree)
rodent

Disease/Solid Waste
Abstracts

No. DSW-162

Author

K. F. Meyer

Title

The Ecology of Plague

Reference

Medicine, 1942, pp. 143, V. 21

Doc. No. Contract No. Date issued

Abstract

The discovery of the disease in recent years as sylvatic plague or plague of the wild rodents in the inland states of the North American Continent has attracted much attention. Rat plague has re-appeared in a Western port subject to restrictions imposed by the International Sanitary Convention. As a cause of death, plague plays a subordinate role. During the past 10 years only 17 cases have been definitely recognized. However, it is feared that the wild rodent reservoirs so widely scattered over 12 Western States and Canada may ultimately extend into the rat infested cities and towns of the Mississippi Valley, or in turn it may re-invade the Pacific Coast cities and visit military encampments, and thus bring again the fearsome seed close to the human habitations. Bubonic plague...is...a self-regulating phenomenon in which man is merely an accidental host...the epidemiology of the wild rodent disease-the effect of the plague bacillus on the rodent herd-is far more important than the data on human cases. The records concerning the statistics and the dynamics of these primary hosts together with their fauna of ectoparasites in the United States are quite incomplete.

In recent years, every true eqizootic among various species of squirrels was invariably proven to be caused by P. *pestis*. Since sylvatic plague tenaciously persists in its original haunts, it is reasonable to conclude in retrospect that previous wild rodent eqizootics in Modoc County and elsewhere in the Western states were, in all probability. not tularemia but plague.

The rise of sylvatic plague in the U.S. was ushered in by the demonstration of plague by the Public Health Service in a Richardson ground squirrel (*Citellus richardsonii*) near Dillon, Montana in 1935 and in *Citellus armatus* in Idaho with the first human bubonic plague infection in Southern Utah. Incident to the human infections in Utah. sylvatic plague was demonstrated for the first time in the marmot (*Marmota flaviventris englehardti*) and prarie dogs (*Cynomys parvidens*). New foci of plague were found in Idaho, Montana and Nevada, and old endemic areas of California revealed renewed and occasionally eqizootic activity .... Infected fleas were encountered in increasing numbers in the pools of the collected

Descriptors

marmot
prarie dogs
Kangaroo rat
Douglas squirrel
cotton-tail rabbit
ecology
plague
flea
domestic rats
ectoparasites
bed bugs

## Abstract (continued)

ectoparasites. Ample evidence promptly confirmed the ever growing suspicion and fear that the disease is prevalent in the North from the International Boundary, in Washington, to the California San Bernardino Mountain Range in the South, and from the West Coast of California into the heart of Montana. The boundaries were subsequently extended in 1938 and 1939 into Catron County of New Mexico, and into Arizona and Wyoming. By 1940 it was recognized in Alberta, Canada, and this year (1941) in North Dakota. Finally, Colorado, through the survey of an eqizootic in San Miguel County, was placed among the 13 Western states now proven infected. New hosts of the plague bacillus, such as the Kangaroo rat and the Washington cotton-tail rabbit, and lately the supposedly immune Douglas squirrel, were added to the already lengthy list of rodents suffering from spontaneous plague.

Why human cases are so sporadic remains a mystery. There must be some inherent unknown weakness in the link formed by the flea, which is responsible for the very infrequent occurrence of the human cases.

How the majority of the 50 bubonic human plague cases, dealing with 41 males and only 9 females, contracted their infection is not discernible from the records, nor has it been possible to get any clear conception relative to the pathways of the infective agent. However, the frequent location of the primary process in the inguinal region, which was not always identified as a bubo, strongly incriminates flea-bites on the limbs. The most usual place, where the infection has been contracted, has been the domestic premises in the rural communities, or the cottages and cabins of summer resorts. With the elimination of rat plague since 1925, exposure to wild rodents is more definitely evident and proven. In the early California cases, contact with domestic rats has not been ruled out to the complete satisfaction of every eqidemiologist. It has become evident, in conjunction with the extensive survey studies all over the West, that not less than 31 species of wild rodents form a reservoir of plague independent of the domestic rat....

The strains of P. *pestis*...are biologically identical with the organisms secured from rats or other rodents in various parts of the World. At least with the methods available today, it is impossible to distinguish biologically a plague bacillus isolated from a wild rodent from that obtained from a rat.

The plague-infected squirrel without visible lesions is best designated as "latent plague or a form of carrier condition, which may be one piece of evidence towards a better understanding of the problem of the persistence of plague among rodents between eqizootics.

To date...investigations of epizootic or enzootic plague areas in the western part of the United States have established spontaneous infections or reservoirs in a total of 31 rodents and rabbits as listed in Table 3.

As a while, the host relationship on the North American Continent is just as involved and differs in no way from that proven for South Africa, Southeast Russia and other sylvatic plague regions where the infection remains localized, since a particular fauna maintains the infective agent.

Complex ecological relationships are created when several species of rodents occupy the same burrow system and the ectoparasite infested nests, either temporarily when in danger of after the death of squirrels. The importance of mice and wood rats is quite evident, but little is known concerning the role of predatory and scavenger birds as studied by Jellison, particularly with respect to the spread of infected fleas.

Abstract (continued)

...the pestiferous fleas vary according to the species of wild rodents .... Over 50 different species have been found on the Western wild rodents. Many rodents harbor only one species of flea whereas others are the normal hosts for several species. This striking host preference may extend to biologically related rodent species or groups. The importance of this preference in the dissemination of the plague bacillus is quite obvious particularly in the light of another fact, namely an interchange of parasites brought about by a fleeting environmental contact of the various rodents inhabiting the same region. Many of the insects attach themselves only while feeding. In consequence, it is difficult to secure a true picture of the ectoparasitic fauna (flea index) by merely counting the fleas found on the wild rodents above the ground. Epidemiologically, of importance is not only the seasonal density but the seasonal flea species composition. Since fleas are active in seeking hosts, a rodent freed from all fleas will acquire what appears to be the normal numberfor that particular season of the year in a very short time, possibly within a few hours.

Concerning the bionomics of the different species of ectoparasites, very little is known....Many of the unknown factors in sylvatic plague are intimately related to the influence of the climatic conditions on the life and longevity of the insects. The "microclimate," the temperature and humidity of the burrow exert their influences on the life-cycle of the flea, and thus on the death-rate of the insect and indirectly on the behavior of the plague bacillus within the body of the ectoparasite. In order to comprehend the importance of these factors, the mechanism of P. pestis transmission through the agency of the flea must be understood. To date, approximately 32 species of fleas collected from American wild rodents have been tested and found capable of accepting an infection. In the tests made by Eskey and Haas, only 13 species of fleas from wild rodents in North America transmitted by their bites. This ability to become infective has been designated by Wheeler and Douglas the the vector potential.... For two species of laboratory reared fleas-the rat flea-Xenopsylla cheopis and the squirrel flea-Diamanus montanus-this potential has been established.

...bedbugs-Cimex lectularius-may carry plague bacilli in the intestinal for at least 147 days...the tick-Rhipicephalus schulzei-on Citellus pygmaeus may cause infection and death in healthy animals.

There need be no doubt that squirrel fleas are picked up by rats and dogs, and the reverse-a transfer of rat fleas to squirrels has been definitely proven. Some of the documentary evidence along these lines is as follows: Diamanus montanus-in all probability the vector par excellence-has been collected from Neotoma, Rattus norvegicus norvegicus in the San Francisco Bay, Los Angeles (1924) and Salt Lake City areas, Rattus rattus alexandrinus and Neotoma cinerea occidentalis and marmots in Oregon, rock squirrels, tree squirrels and prarie dogs in Colorado, and the wolverine in British Columbia. In the surrounding territories of Los Angeles, the Diamanus index on rats in 1933 varied from 1.64 in Whittier to 4.4 in Pomona (R. V. Stone). Hoplopsyllus anomalus was likewise demonstrated on Norvegicus rats in San Francisco and the cotton-tain in Monterey County Beecheyi squirrels caught in the Belvedere district of Los Angeles carried on the average 3 Xenopsylla cheopis (R. V. Stone); similar findings have been reported from Salt Lake City.

Abstract (continued)

In order to be guided for the investigation of future eqizootics, the published reports by Kalabukhov and Raevskii on the life-cycle of Citellus pygmaeus, and the laws governing the development of sylvatic plague epizootics in Southeast Russian endemic region deserve particular interest. Of importance is the fact that the animal epizootics depend on the endemicity or more specifically on the persistence of plague. Although the Russian workers give no answer to the pertinent question: How does this endemicity arise? they do point out that wherever there is a given species of rodent in sufficiently large numbers, "a chance introduction of infection by other animals or by man can lead to the formation of a new center". What these animals may be is not stated, but the rat (Rattus norvegicus) is mentioned. For practical purposes, Pirie, who has made dependable field observations in South Africa, believes that the flea is the all-important factor in the persistence of plague. When rodents are few in number, the disease would be of a quiet, smoldering type; a squirrel infected every here and there at 2 months interval would be sufficient to keep the disease alive. As the number of rodents increases and the fleas presumably increase in response to environmental factors, contacts would be more easily made and the number of cases would increase.

This sketchy survey of the ecology of sylvatic plague has left a great deal unanswered, because knowledge is either not available or it is burdened by hypotheses not in harmony with newer ecological thought. Contrary to the belief too often held by the laity and even by those who are familiar with sylvatic plague, an epizootic among wild rodents is by no means always followed by human P.pestis infections.

Disease/Solid Waste
Abstracts

No. DSW-163

Author

C.M. Wheeler & J. R. Douglas

Title

Transmission Studies on Sylvatic Plague

Reference

Soc. for Experimental Biology, Proc. 47:65-6

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| (1941) | | |

Abstract

The evaluation of the vector efficiency of a species of arthropod incriminated in the transmission of an infectious agent must necessarily take into consideration the following factors: (1) the infection potential, (2) the vector potential, and (3) the transmission potential. The infection potential is based upon the percentage of a given species in which the infection becomes established or the disposition of this species to accept the invasion of the organism of the infection. The vector potential is based upon the percentage of infected individuals which become infective. The transmission potential is the mean number of transmissions effected by a group of infective individuals. The product of these factors will represent the number of transmissions effected by a given number of any species or the vector efficiency.

To determine if a given species of flea was capable of transmitting *Pasteurella pestis* (Yersin)mass feeding experiments were first conducted. When transmission ability was established in a species this species was then tested to determine the vector efficiency by daily individual feedings. Mass tests were conducted with *Diamanus montanus* (Baker) and *Hoplopsyllus anomalus* (Baker), predominant species of the California ground squirrel, Citellus beecheyi (Richardson), *Nosopsyllus fasciatus* (Bosc) and *Xenopsylla cheopis* Rothschild, the principal fleas of rats, Rattus spp., *Malareus telchinum* Rothschild of the field mouse, *Microtus californicus* (Peale), and *Ctenocephalides felis* (Cirtis) of *domestic cats*, *Felis domestica* Linn.

Successful transmissions were obtained with D. *montanus*, C. *felis*, N. *fasciatus*, X. *cheopis* and H. *anomalus*.

Although X. *cheopis* has a higher infection potential than D. *montanus*, only one-half as many X *cheopis* become infective and these transmit but one-half as many times. Apparently then a high infection potential alone is no indication of high vector efficiency.

Descriptors

transmission studies
sylvatic plague
infection potential
N. *fasciatus*
arthropod
transmission potential
*Pasteurella pestis* (Yersin)
X *cheopis*
vector potential
D. *montanus*
C. *felis*
H. *anomalus*

Disease/Solid Waste
Abstracts

No. DSW- 164

Author Karl F. Meyer, M.C.

Title The Natural History of Plague and Psittacosis

Reference Public Health Report

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Vol. 72, No. 8, p. 705 | | Aug. 1957 |

Abstract

The suppression of certain epidemic diseases in relatively small areas has in no way influenced parasitism in general. The everlasting question, what forces create, maintain, and suppress epidemic diseases of man and animals? has never been fully answered.

Study of the prime incitant of disease and tracting it to its natural environment share importance with appraisal of the spectrum-like individual, clinical, and immune variations within an infected group. Bacteria and probably viruses are infinetely adaptable and versatile. Bacteria vary and mutate. Successive generations of bacteria may differ fundamentally from those that preceded them, and the physical and chemical effects expressed as virulence produced by a bacterial population, even in a defined environment, cannot necessarily be predicted on the basis of previous experience. Allowing for variation, mutation, such sexual activities as transduction and transformation, and the appearance of a new generation every 20 to 30 minutes, change in infectious agents in so inconstant an environment as man and animals should surprise no one. How can a thoughtful student accept the view that the infectious diseases are losing their importance and that they will probably be conquered within a decade? November 1924 another outbreak, this time in Los Angeles. The epidemiology of the Los Angeles outbreak has never been critically analyzed. On epidemiological grounds it is believed that secondary pulmonary invasion developing from bubonic plague of rat flea origin started the epidemic. Two possible sources of the infection in Los Angeles rats in 1924 were investigated; (a) infection in rats brought in from foreign ports through San Pedro, the port of Los Angeles, and (b) infection in ground squirrels in the area.

The first possibility was dismissed because plague-infested rats could not be located in the port. The second possibility seemed to fit the circumstances. The rats in that area did have contact with squirrels; infected squirrels were found in the urban section of the city; and squirrel fleas were found on the

Descriptors

natural history
plague
psittacosis
epidemic diseases
bacteria
viruses
epidemiology
rats
ground squirrels
fleas
wild rodents
pigeons
chickens
ducks
turkeys

rats. The interchange of fleas between wild rodents and commensal rats had been recorded earlier (3-5) and has been observed since(6).

In the Rift Valley of Kenya the ecologically unstable plains are ideal for dissemination of *P. pestis* when conditions are suitable, but the infection retreats to the foothills between epizootics among the highly susceptible domestic rats.

The pathogenesis of the infection after the introduction of *P. pestis* through the bite of a blocked infectious flea can be readily followed in these animals. It follows a standard pattern. afferent lymphatics to regional lymph nodes, to efferent lymphatics, to thoracic duct, to blood stream, to liver and spleen. When the bacteria multiply to such an extent that the liver and spleen can no longer filter them out, they appear again in the circulatin blood. Active multiplication of *P. pestis* in the bloodstream, so essential to infection of the flea, is always terminal.

Clinical and X-ray examinations and blood cultures demonstrated that primates exposed, with or without body contact, to cage mates suffering from primary pulmonary plague may contract plague and die.

Psittacosis: Under stress of egg laying and hatching, the hen with latent infection excretes virus through the alimentary canal. With respect to psittacosis arising from nonpsittacine birds, epidemiological histories invariably report that the patient handled sick or visibly diseased carcasses of birds or was exposed to a flock that at the time of exposure or shortly before contained sick birds. Despite the extent of the avian reservoir, the human infections are mild and infrequent.

Now a new ecologic problem has arisen. Infections among poultry workers and rendering plant employees comprise 398 (nearly a fourth) of the 1,687 human psittacosis cases reported in the United States in the past 5 years. These have been due to exposure to anatomically diseased poultry, principally turkeys. In outbreaks in Texas, New Jersey, and Oregon highly virulent isolates from the viscera of poultry have been identical to those isolated from these two plant workers in Texas and Oregon.

There has been little opportunity to study the natural history of ornithosis in the turkey flocks responsible for the explosive outbreaks of human illness in processing plants. The droppings of the acutely diseased birds contain the parasite in abudnance. The parasite may be introduced into the flock by wild birds, by other turkeys, through eggs, contaminated feed, or biologics, or even by visitors to the ranch.

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Disease/Solid Waste
Abstracts

No. DSW-165

Author K. F. Meyer, M.D.

Title The Modern Outlook on Plague in California

Reference California Vector News

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Vol 2. No. 9, p. 42 | | Sept. 1955 |

Abstract

Because plague during the last 3,000 years has shown itself to be subject to periods of as yet not fully explained quiescence, it is wiser to view the present level as a plateau of unknown length and to resist the temptation to draw conclusions about the causes.

The building of suburbs ultimately makes a habitat unsuitable for maintaining appreciable wild rodent populations, but there is at least an inital period of joint tenancy by people and wild and commensal rodents--a condition theorectically ideal for the propagation of plague. The wilderness recreational areas of California have been crowded with more people every year. This too has increased the opportunity for close contact between man and reservoir animals and ectoparasites. Potentially the public health hazard has been increased by these two changes.

The effectiveness of control is almost impossible to evaluate. That clinical plague must be recognized at once is particularly difficult because almost no physician in the United Staes ever sees this disease.

The wild rodent reservoir of plague constitutes a threat to the human population in two ways: If their ectoparasites become infected and then infect commensal rats that in turn infect their ectoparasites, the infection chain is brought into the immediate environment of human beings and the likelihood of including them is very much increased. In newly suburganized areas. In organized recreational areas, on ranches and particularly around refuse disposal sites, *Muridae*, *cricetidae* and *sciuridae* live in intimate contact. There is ample evidence that under such circumstances fleas are interchanged. It is not too great a step from this interchange to an epizootic among the *Cricetidae* and/or the *Muridae* and consequently to danger to human beings. This is most menacing.

Because protection of the public health is the end of control measures, the commensal rodent must also be recognized as a highly relevant link. Particularly in areas where the infection is known to exist in wild rodents,

Descriptors

wilderness recreational areas
public health hazard
wild rodent
reservoir
commensal rats
link

the commensal rodents should be attacked, and perhaps should comprise the real target of the attack. Inhabitants must be taught the dangers in these expensive parasites on their granaries and household food stores. As a general measure, houses and farm buildings in these, and in fact in all, areas should be constructed so that rodents cannot gain entrance.

No. DSW-166

Author
Robert W. Jones

Title The Public Health Significance of Rodents in California

Reference California Vector News

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Vol. 3 No. 7 pgs. 32-34 | | July 1956 |

Abstract

The list of diseases transmissible to man from rodents is length. Plague, murine typhus, leptospirosis, salmonellosis, tularemia, relapsing fever, Rocky Mountain spotted fever, and other.

The smaller native wild rodents such as Peromyscus spp. and Microtus spp. to be far more important as reservoir animals in the sylvatic plague complex than is citellus. Experience through the years has shown human cases of plague resulting from contact with native wild rodents to be relatively few and far between. In actuality during the past 25 to 30 years there has been an average of only one human case of plague each two years. There still remains, however, the potential hazard of the introduction of the plague organism from the wild host to the domestic rat through an interchange of infected fleas. Our chief danger, then, would appear to lie in those areas where contact between the wild and domestic rodents is greatest and most intimate. Areas such as refuse dumps on the outskirts of a community, new subdivisions being developed on land which was previously agricultural or waste, and to a certain extent, the vast undeveloped recreational areas of the State, are those areas where intimate contact allowing the interchange of ectoparasites, would be most likely to occur.

The domestic rodents with which we are concerned are Rattus norvegicus, the wharf or sewer rat; Rattus rattus, the roof rat; and Mus musculus, the domestic mouse. All of these are Old World residents introduced to this country which have spread through all of the inhabited areas. These parasites of man are hazardous as disease carriers: Salmonellosis, murine typhus, and leptospirosis are the rodent-borne diseases of most concern to public health now. The basic control of domestic rodents is always to remove food and harborage or make these items otherwise unavailable to the rodents. Basic sanitation comes first.

The Bureau of Vector Control is emphasizing the control of domestic rodents as the most practical method of protecting the public from plague. Successful control operations must be based primarily upon basic sanitation measures which will make food and harborage unavailable to domestic rodents. Supplementary control depends upon ratproffing, poisons and traps.

Descriptors

diseases
Plague
murine typhus
leptospirosis
salmonellosis
tularemia
relapsing
Rocky Mountain spotted fever
Rattus norvegicus
Rattus rattus
roof rat
Mus musculus

**Disease/Solid Waste**
**Abstracts**

**No.** DSW- 167

**Author**

Hull, T. G.

**Title**

"Diseases Transmitted from Animals to Man"

**Reference** Chas. C. Thomas, Springfield
5th Edition, 1963

**Doc. No.** **Contract No.** **Date issued**

No. RC-112-H877, pp. XVII & 967

**Abstract**

This book is divided into three sections:

(1) Diseases of Domestic Animals and Birds and Occasionally of Wild Animals and Rodents.
(2) Diseases of Rodents and Wild Animals and Occasionally of Domestic Animals
(3) The Relation of Human and Animal Diseases

There are 43 chapters covering individual diseases.

While the format is not entirely consistent, each chapter tends to cover some historical information, etiology, epidemiology, some pathology, and prevent and control. There is generous use of illustrations of both animal and human disease, tables and graphs and references. The book appears well indexed.

**Descriptors**

disease
animals
zoonoses
birds
ecology
epidemiology
etiology
prevention
control
protozoa
hosts
insects
incidence
prevalence
transmissibility
vectors
rodents
arthropods
distribution
helminths
geography
imminology
serology
symptomatology
treatment
diagnosis
pathogenicity
bacteriology
viruses

Disease/Solid Waste
Abstracts

No. DSW-168

Author Carl C. Dauer, M.C.

Title 1960 Summary of Disease Outbreaks and a 10-Year Resume

Reference Public Health Report

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Vol. 76, No. 10, p. 915 | | Oct. 1961 |

Abstract

The 11 waterborne disease outbreaks reported in 1960 included 2 small outbreaks of typhoid fever, 2 cases in one outbreak and 6 in the other; 3 of hepatitis; 2 of shigellosis or bacillary dysentery; and 3 of gastroenteritis. Only 1 of the 11 outbreaks was attributed to a public water supply. A large number of cases of shigellosis occurred after a breakdown in a town's water treatment plant. All other outbreaks were associated with the use of water from wells or springs.

The four outbreaks of typhoid fever included one that was clearly waterborne, one that probably was waterborne, and two that were foodborne. In the first outbreak, six users of well water developed the disease. Investigation demonstrated that the well was contaminated by seepage from a septic tank used by a known carrier. In the othersmall outbreak the two persons affected lived in crowded, unhygienic surroundings and had used water from a well that was susceptible to contamination from a septic tank. A resident of the immediate area who used these sanitary facilities was found to be a typhoid carrier.

Seventeen outbreaks of salmonellosis were reported. One was considered milkborne, and the remainder were foodborne. One of the outbreaks associated with custard-filled desserts was believed to have been caused by contamination of the food with rat droppings.

Salmonella typhimurium was isolated in five outbreaks, S. heidelberg in four, and S. enteritidis, S. manhattan, S. montevideo, S. newport, and S. oranienburg in one each. The specific type was not reported in the three remaining outbreaks. All outbreaks of shigellosis reported in 1960 were caused by Shigella sonnei infections. One waterborne outbreak followed a breakdown in the water treatment plant of a town. Another outbreak was traced to the water from a spring in a picnic area. Another rather large outbreak was reported in which the epidemiologic evidence pointed to some food eaten in a school cafeteria. In another instance students who ate in a college dining hall became ill with

Descriptors

Disease
waterborne disease outbreaks
typhoid fever
shigellosis
bacillary dysentery
gastroenteritis
water
wells
springs
salmonellosis
rat droppings
Salmonella typhimurium
S. Heidelberg
S. enteritidis
S. manhattan
S. montevideo
S. newport
S. oranienburg
hepatitis cases
shigellosis
Shigella sonnei
waterborne outbreaks
food poisoning
epidemiology

with diarrhea, which was confirmed as shigellosis by laboratory tests of specimens. *S. sonnei* was isolated from the stools of a cook who had gastroenteritis 5 days before the outbreak. In another outbreak, *S. sonnei* was also isolated from a person who prepared potato salad for a buffet supper in a home.

The toal number of hepatitis cases, including both infectious hepatitis and serum hepatitis reported in the United States increased from about 23,500 in 1959 to about 40,000 in 1960. Epidemiologic investigations indicated that three outbreaks could be classed as waterborne and one as foodborne. Two of the three waterborne outbreaks occurred among school children whose drinking water at their schools came from wells. In each instance contamination of the wells with sewage was demonstrated. The other outbreak affected five different groups of persons who had picnics in a park where, it was stated, the water supply was inadequately chlorinated. Eleven students who had their meals in a college dining hall developed infectious hepatitis. Since one of the food-handlers had been hospitalized with hepatitis about 3 weeks prior to onset in the students, this outbreak probably can be considered foodborne.

Gastroenteritis, Etiology Unknown: In more than half of the 1960 outbreaks the suspected vehicle of infection was poultry or other meat. About one-third were caused by food served in public eating establishments such as restaurants and hotels.

Summary of Disease Outbreaks, 1951-60: In the 10-year period ended in 1960 about 2,300 outbreaks were reported, 65, or about 3 percent, of which were waterborne. The total number of cases recorded was almost 100,000. It is probable that many foodborne disease outbreaks occur, particularly family outbreaks, which never come to the attention of local authorities. It has been variously and conservatively estimated that the actual number of foodborne and waterborne disease outbreaks is at least 10 to 20 times larger than the reported number. A recent report on food poisoning in England and Wales (1) shows that the average annual number of "general outbreaks," which are defined as two or more cases in persons in different families, was 9.8 per million population during the 5-year period 1949-53. The rate for the United States was 1.4 for the period 1951-55. A more effective system of collecting information in England and Wales probably accounts for much of this wide difference in number of outbreaks.

In disease caused by *Salmonella* organisms, the wide distribution of the many types of this organism in many species of animals with which man has contact or may use as food makes it difficult to prevent transmission to man. In addition to the animal sources of infection, human carriers and patients have many opportunities to contamimate food. It can be argued persuasively that there is a real need to improve the reporting of both waterborne and foodborne illness as the first step in the development of effective control measures. There also is real need to study more intensively and extensively the epidemiology of staphylococcal food poisoning and Salmonella infections because their causative agents are widely distributed and their ecologic factors are complex.

## References

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Disease/Solid Waste
Abstracts

No. DSW- 169

Author E. E. Halmos, Jr.

Title Missle Base Water and Waste Facilities

Reference
Water and Sewage Works

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pgs. 176-179 | | April 1964 |

Abstract

The more than 66,000 Merritt Island area will have no permanent residents, but its daily population is expected to reach about 10,000 persons. It would appear that waste disposal would be a real problem in an area that is nowhere more than seven feet above groundwater, and in many places less than three feet higher than surrounding water levels.

All water for drinking and process use in the area is being piped from well fields a total distance of as much as 25 miles. There's no problem of contamination of local underground supplies. No important quantities of chemicals can reach groundwater, since little handling of chemicals (except in one building) is to be done on the site. Wastes from more normal industrial processes, such as truck and machine repair shops are handled by individual septic systems for buildings where such operations are carried out. Activated sludge treatment plant: the installation contains two settling tanks, a sludge holding tank and two aeration tanks. Effluent is carried through a concrete-pipe outfall to the open-ditch field drainage system.

Descriptors

missile
waste disposal

Disease/Solid Waste
Abstracts

No. DSW- 170

Author
Roland C. Hartman

Title
Composting Controls Flies (and saves Money) at Poultry Ranch

Reference
Compost Science

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pgs. 26-28 | | Spring 1963 |

Abstract

The fly situation was not always under control. There was a time when they were so thick that workers doing the feeding and egg gathering had to cover their mouths with rags or handkerchiefs when going through the houses. What apparently has solved the fly problem is a program of composting the droppings. As a result of composting, he has an easy-tohandle-saleable organic fertilizer that returns enough to cover his costs, overhead and maintenance of his equipment for handling the manure. Removal of the manure is a twice-a-year job.

Originally, it was the practice to clean out the manure right down to the ground. Now the workers use a broad fork and dig into the pile at a point about 6 inches above the ground. This base, which contains the bacteria that are responsible for composting, is loosened and leveled to form a pad of about 6 inches high. This base is dry enough that it prevents moisture from being drawn up from the ground by capillary action into the fresh droppings and creating a condition that aids fly breeding. At weekly intervals, for four weeks after establishing the pad, a spray containing an enzyme to the droppings to assist composting is applied. Afterward, the spraying is done at monthly intervals. There is good air circulation to aid drying of the manure. Control over feed is such that the production of wet droppings is prevented. Removal of wet areas of manure is extremely important. When the manure is removed from below the cages, it is transferred to another area to complete the composting process. It is spread out to a depth of 3 to 4 feet, then it is sprinkled with water.

The next step is to put the manure into windrows 7 or 8 feet high, turning it over twice a week with a scoop on a tractor for a period of five or six weeks. This completes the composting job, and even the feathers seem to be completely disintegrated. It results in a fertilizer that is easy to handle.

In areas where there is excellent drying of droppings in cones below cages, will flies still be attracted to the fresh droppings which fall on the cones? Why are they not attracted to the fresh droppings which fall on manure

Descriptors

composting
poultry ranch
house fly
fertilizer
costs
manure
research

which is composting? Are they repelled by some odor that is given off by the composting manure? This is something that scientists may want to investigate.

Disease/Solid Waste
Abstracts

No. DSW- 171

Author
Ralph J. Black and Allan M. Barnes

Title Effect of Earth Cover on Fly Emergence from Sanitary Landfills

Reference
Public Works

| Doc. No. | | Contract No. | Date issued |
|---|---|---|---|
| V. 89 | pgs. 91-94 | | Feb., 1958 |

Abstract

House flies emerged through five feet of uncompacted earth cover. Of the several thousand species of flies in California, many are found in mixed refuse at various times because of its heterogeneous nature. The important fly species occurring in mixed refuse use the same means as house flies to force their way through soil. Eggs are deposited in moist organic matter in the refuse before it is collected, and also at the disposal site if the refuse is not promptly covered with earth.

In order to prevent fly emergence by compacting the cover material at sanitary landfills there are four essential factors to consider: (1) soil that can be compacted, (2) suitable equipment for compacting the soil, (3) adequate range of soil moisture, and (4) adequate thickness of cover. Nearly pure sands, clays, or silts are not suitable for compaction on sanitary landfills. Crushed rock with no soil binder is likewise unsuitable. A bulldozer appears suitable for soil compaction with repeated tracking over the cover material. Where only a dragline is used, additional equipment is needed. There is apparently a wide range of moisture content which permits sufficient compaction to prevent fly emergence. The amount of moisture necessary varies according to the soil. Under usual field conditions, a 6-inch layer of compacted cover should prevent fly emergence.

Even if soil conditions are not suitable for compaction, the fly production problem can be greatly reduced by spreading and compacting the refuse and then promptly covering it with soil. Only a thin covering is necessary to prevent flies from laying more eggs on the refuse at the disposal site. This is critical only during warm weather. During cool weather, when adult flies are not numerous, covering can be less frequent unless there is a major source of flies nearby.

Descriptors

Musca domestica
earth cover
fly emergence
house fly
compacting
sanitary landfills

Disease/Solid Waste
Abstracts

No. DSW- 172

Author
K. F. Meyer

Title The Prevention of Plague in the Light of Newer Knowledge

Reference Annals New York Academy of Sciences

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| V. 48 (1947) pgs. 429-67 | | 1947 |

Abstract

The role of plague-stricken rats came to prominent notice in Cape Town, South Africa, where plague cases were promptly removed to hospitals and infected clothing was disinfected and yet the epidemic continued to develop. The majority of plague cases were then traced to dead or infected rodents found at the residences and workshops of those attacked by the disease. The history of the epidemics in Sydney, Australia, in 1900 and 1901, and in Brisbane, in 1901 and 1902, established in both time and place the close relationship existing between the incidence of rat plague and the subsequent occurrence of human plague.

Carlo Tiraboschi,[46] after studying plague in Genoa, assembled in a classical paper overwhelming evidence in favor of the fundamental importance of plague among rats. The Plague Research Commission, working in Bombay between 1905 and 1907, brought forward much evidence to support the view that the rat flea plays an important role in the spread of plague. It became overwhelmingly evident that fleas, and fleas alone, were the transmitting agents of plague infection, with the exception of pneumonic plague. Any human infection is an accident which depends upon contact with the rat and its fleas. Effective prophylaxis of plague must be preceded by a persistent educational campaign designed to make the public anti-rat minded. Anti-flea measures are imperative in combating human and murine plague.

The slogan, "no rats, no plague," as generally promulgated by the unitiated, ignores the fact that wild rodents are potentially more dangerous as endemic plague foci than are rats. The infection of wild rodents, now designated as sylvatic plague, is preeminently confined to the brush, desert, and mountains of China, the Bureat-Mongol Republic, Trans-Caucasia, southeast U.S.S.R., South Africa, Argentina, and the United States. The significance of these plague foci cannot be underestimated for the following reasons: (1) Frequently, not one but several species of rodents are seriously involved in the same plague focus; (2) The habits of the rodents and their ectoparasitic fauna may show great differences, and their relationship to man will, consequently, be subject to noteworthy variations;

Descriptors

plague
protective inoculation
immune sera
chemoprophylaxis
rat plague
rat flea
wild rodents
sylvatic plague

(3) There is increasing evidence that the original plague agent evolved in wild rather than in domestic rodents.

Perusal of early California cases supposedly of sylvatic origin has not ruled out to the satisfaction of every epidemiologist the role of the domestic rat as a vector.

The outbreak in Los Angeles, in 1924, followed a transfer of plague from infected ground squirrels to rats. A close association between rats and field rodents has been observed around human habitations in rural areas, and around city garbage dumps. Prince[67] and other workers found rats carrying fleas belonging to species not ordinarily regarded as rat fleas. Spread of plague from wild rodents to urban rats constitutes one of the dangers emanating from the sylvatic plague areas. Reappearance of plague in the rats of the San Francisco Bay area and in Tacoma, during the past few years, indicates that ectoparasitic vectors are finding their way from infected wild rodents to rats and mice in or near these coastal centers of population.

The elimination of rat and mouse harborages in, and for many miles around, towns is of the greatest importance in safeguarding the inhabitants of small communities. The maintenance of so-called "rodent-free" belts around towns is imperative.

References

46 Tiraboschi, C. Arch. f. Hyg. Munchen. u. Berl. 46: 251-263. 1903. Also, Arch. de parasitol. 8: 161-349. 1904

67 Prince, Frank M. Publ. Health Rep. 58: 700. 1943

Disease/Solid Waste
Abstracts

No. DSW- 173

Author
Michael L. Furcolow

Title
Recent Studies on the Epidemiology of Histoplasmosis

Reference
Annals of the New York Academy of Sciences

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| Vol. 72, Art. 3 Pgs. 127-164 | | Apr. 10, 1958 |

Abstract

In contrast to the many diseases transmitted from person to person by contact or by arthropod or other insect or animal vectors, histoplasmosis and coccidioidomycosis appear to be diseases of nature. The infecting organisms in these diseases grow freely in the soil and are disseminated to human beings through the medium of inhalation of the spores.

It is difficult to see, in view of the distribution of the fungus, how birds could carry the organism in their stools without causing the disease to become more widespread than it is. The organism grows well only at 100 per cent relative humidity and over a relatively limited temperature range, and it does not grow at very high or low temperatures.

The conversion to a positive histoplasmin skin test is not a chance phenomenon. It appears that 80 per cent of the positive children in Kansas City can be accounted for by this phenomenon of having lived on or visited a farm.

Summary: The present theory is that fungus H. capsulatum appears to be limited to its present geographic ozone by conditionsof temperature and humidity. The fungus is spread throughout this and adjacent areas by the prevailing winds and, occasionally, by tornadoes. It grows in localized places where the micro-climatic conditions of temperature and humidity are satisfactory and not in any generalized manner. Finally, it appears to infect people who come to these localized sites and inhale the spores growing there.

Descriptors
coccidioidomycosis
fungus
humidity
temperature

Disease/Solid Waste
Abstracts

No. DSW-174

Author

Willy Burgdorfer & Carl M. Eklund

Title

Studies on the Ecology of Colorado Tick Fever Virus in Western Montana

Reference

Am. J. Hyg. 1959, Vol. 69:127-137

| Doc. No. | Contract No. | Date issue |
|---|---|---|

Abstract

SUMMARY

1. In studying the ecology of Colorado tick fever (CTF) virus in a small region of western Montana in 1958, immature and adult *Dermacentor andersoni* and their most common host animals wereinvestigated to ascertain their importance in maintaining and distributing the virus.

2. The golden-mantled ground squirrel (*Citellus lateralis fescorum*)was found to be a preferred host for immature D. *andersoni* and the main carrier of CTF virus. In the months of June, July, August and September, 61 captured specimens yielded 28 (45.9 percent) virus isolation. In areas populated by this species of ground squirrels, the incidence of virus-carying adult ticks collected from begetation was as high as 16 percent.

3. From 209 Columbian ground squirrels (C. *columbianus columbianus*) tested, 27 (12.9 percent) virus isolations were made. The earliest isolation occurred on May 13, and the latest on August 21. The majority of infected squirrels was found in an area that was inhabited also by golden-mantled ground squirrels. In adjacent areas where the latter species was not present, lower infection rates in ticks as well as Columbian ground squirrels were found. N isolation of CTF virus could be from adult ticks and rodents in an area that was populated only by a large colony of these squirrels.

4. CTF virus was also isolated from the blood samples of 5 of 26 chipmunks (*Eutamias amoenus*), 1 of 4 pine squirrels (*Tamiasciurus hudsonicus richardsoni*) ar 1 of 6 deer mice (*peromyscus maniculatus*), but not from the blood of 2 porcupines (*Erethizon dorsatum*) and 4 snowshoe rabbits (*Lepus americanus*).

5. CTF appears to be characterized by sharply localized areas of infection correlated in this instance with the presence [illegible] the golden-mantled ground squirrel.

Descriptors

chipmunks (*Eutamias amoenus*)
porcupines (*Erethizon dorsatum*)
snowshoe rabbits (*Lepus americanus*)
*Dermacentor andersoni*
CTF virus
Columbian ground squirrels
(C. *columbianus columbianus*)

pine squirrels (*Tamiasciurus hudsonicus richardsoni*)
host animals

deer mice (*Peromyscus maniculatus*).
Colorado tick fever (CTF)
golden-mantled ground squirrel (*Citellus lateralis tescorum*)

Disease/Solid Waste
Abstracts

No. DSW-175

**Author**

C. W. Emmons

**Title**

Ecology of Histoplasma and Other Pathogenic Fungi

**Reference**

Amer. J. of Pub. Health, May 1957, pp. 616

| Doc. No. | Contract No. | Date issu |
|---|---|---|
| p. 615 | | |

**Abstract**

A factor common to many of these locations was the presence of fecal material of chickens or other birds, although the natural occurrence of the disease in birds has never been proved, and chickens are not susceptible to progressive or chronic experimental infection.

The most probable explanation for the presence of Histoplasma in these sites is that the fungus grows as a saprophyte in a suitable soil and is quite independent of any animal host.

Histoplasma may persist in soil for long periods after the environmental conditions with which its presence is usually associated have been altered. The fungus has been isolated from garden soil, from heaps of chicken dropings left in exposed sites on a hillside, and from beneath bluegrass sod three years after the removal of a chicken house from the site. In the laboratory Histoplasma has survived as long as 180 days in sterilized tap water.

One can conclude that fungi capable of causing human disease are frequently present in varied environments, that man must be frequently exposed to them by inhalation or trauma and that such exposures probably lead only rarely to progressive and fatal disease.

**Descriptors**

Histoplasma
droppings
soil
fecal material
litter

**Disease/Solid Waste
Abstracts**

No. DSW-176

Author J. L. Melnick, R. Ward, D. R. Lindsay, and F. Earle Lyman

Title

Fly-Abatement Studies in Urban Poliomyelitis Epidemics During 1945

Reference

Pub. Health Rep. V. 62 #25, 1947, pp. 910

Doc. No. Contract No. Date issued

Abstract

Poliomyelitis virus has been demonstrated repeatedly in or on flies trapped in epidemic areas in various parts of the country (1), (2), (3), (4), (5). ... food exposed to flies at homes of polomyelitis patients has been shown to become contaminated with virus (6).

SUMMARY

DDT was applied in two poliomyelitis epidemic areas, each with an area of about 4 square miles and inhabited by some 67,000 and 27,000 people, respectively. A temporary reduction in flies was achieved in both areas. Under the circumstances, which were not ideal, there was no effect on the poliomyelitis control. ... That they did not answer successfully the major question either in a positive or negative direction was due to the following facts: (1) Poliomyelitis rates in Paterson, N.J. were hardly at the epidemic level, (2) spraying in Rockford, Ill., did not commence until after the outbreak had passed its peak, and (3) striking and prolonged fly control was not achieved. The inconclusive results obtained in this work can not be accepted, therefore, as a final answer to the question.

**Descriptors**

poliomyelitis epidemics DDT
Fly-abatement

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(2) Trask, J.R., Paul, J.R., and Melnick, J.L: The detection of poliomyelitis virus in flies collected during epidemics of poliomyelitis. J. Exp. Med., 77:531-544 (1943).
(3) Sabin, A.B., and Ward, R.: Flies as carriers of poliomyelitis virus in urban epidemics. Science, 94:590-591 (1941).
(4) Toomey, J.A.; Takacs, W.S.; and Tischer, L.A.: Poliomyelitis virus from flies. Proc. Soc. Exp. Biol. and Med., 48:637-639 (1941)
(5) ————————: Insects and epidemiology of poliomyelitis. Science, 95:300-301(1942)
(6) Ward, R.; Melnick, J.L.; and Hortsmann, D.M.: Poliomyelitis virus in fly contaminated food collected at an epidemic. Science, 101:491-493 (1945).

Disease/Solid Waste
Abstracts

No. DSW-177

Author

R.E. Dyer, E.T. Ceder and W.G. Workman

Title

Transmission of Endemic Typhus by Rubbing Either Crushed Infected Fleas or Infected Flea Feces into Wounds

Reference

Pub. Heal. Rep. Vol. 47, No. 3, Jan. 15, 193

Doc. No. Contract No. Date issu

pp. 131

Abstract

...fleas (Xenopsylla cheopis) were readily infected with the virus of endemic typhus by allowing them to feed on infected white rats. Further, it was found that these fleas were able to transmit endemic typhus from rat to rat under conditions similar to those occurring in nature. ...fleas infected with endemic typhus retained the infection for...at least 52 days. Since a rat infected with typhus presumably remains infectious for arthropods for only a relatively short time and the fleas apparently retain their infection throughout life, the importance of the flea in perpetuating the virus in nature is apparent.

SUMMARY

Fleas (Xenopsylla cheopis) infected with endemic typhus by feeding on infected rats were crushed and rubbed into scratches on the skin of guinea pigs. These guinea pigs showed an indefinite febrile reaction but no scrotol lesions. The virus of endemic typhus was recovered from them.

Feces of infected fleas scratched into the skin of guinea pigs transmitted endemic typhus. In this instance these guinea pigs suffered a typical infection (signs of infection being absent in one), but the virus of the disease was recovered readily from their brains and spleens.

Conclusion - The foregoing work adds additional weight to the suggestion previously made (6) that a probable mechanism by which endemic typhus may be transmitted is through the rubbing of infected flea feces into wounds made by the biting of the flea or by scratching.

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(6) Ceder, E.T., Dyer, R.E. Rumriech, A., and Badger, L.F.: Pub. Health Rep., 46:3103 (Dec. 25), 1931

Descriptors

virus
Xenopsylla cheopis
endemic typhus
rat
feces
rat fleas
man

Disease/Solid Waste
Abstracts

No. DSW-178

Author

Paul P. Maier and Walter C. Baker

Title

Municipal Fly Control by Environmental Sanitation

Reference

Modern Sanitation, V. 3, 1951, pp. 20

| Doc. No. | Contract No. | Date issu |
|---|---|---|
| | | |

Abstract

SUMMARY

During the period of April, 1949 to July, 1950, studies were made in four towns in Hidalgo County in the Lower Rio Grande Valley of Texas to evaluate sanitation factors related to fly populations and to determine the degree of fly control which small municipalities might achieve through the use of various sanitation improvements. The fly population, as determined by grill counts, consisted almost entirely of the house fly (*Musca domestica*), a blow fly (*Phaenicia spp.*) and a species of *Sarcophagula*.

Proper disposal of citrus and vegetable wastes was actively promoted by the Hidalgo County Health Unit. Except for one small area, this activity has eliminated nearly all foci of intense fly breeding which had previously resulted in extensive migration of flies to nearby towns.

A sanitary land fill for proper garbage and vegetable waste disposal was established by Mission, Texas. This land fill serves as a demonstration model and results clearly show that it is a practicable and effective procedure for fly control at city dumps in this area.

The present level of premises sanitation that is maintained in Anglo-American areas of Pharr, Mission, and Edinburg has consistently resulted in very low fly populations. Adjacent poorly sanitated Latin-American areas have experienced excessive fly populations with definite seasonal fluctuations. These Latin-American areas have almost five times as many occurrences of fly attractants per 100 premises as are found in the Anglo-American areas. They have about a third as many adequate garbage storage facilities and city sewer connections per 100 premises.

From the overall results of the studies in the Lower Rio Grande Valley it is apparent that improvement of environmental sanitation practices is an effective and practicable means for municipalities to control flies.

Descriptors

sanitation
house fly
*Sarcophagula*
sanitary landfill
fly populations
*Musca domestica*
citrus and vegetable wastes
garbage
fly control
blow fly (*Phaenicia* spp)
bly breeding

Disease/Solid Waste
Abstracts

No. DSW-179

Author

S. N. Pokrovsky et G. G. Zima (Stalingrade)

Title

Flies as Carriers of Helminth Eggs under

Natural Conditions

Reference

Meditsinskaya Parazitologiya

Doc. No. Contract No. Date issue

i Parazitarnye Bolezni, V. 7, 1938, p. 26

Abstract

1. There is not the least doubt that flies are carriers of helminth eggs, chiefly on the feet.

2. According to our observations, flies can carry the eggs of Enterobius verinuculars, of Diphyllobotrium,of Ascaris, of Hymanolepsis as well as the cysts of protozoa.

3. Among the fly species examined, Sarcoplraga & Callisphora were the most infected.

4. Aheution is drawn to the elevated percentage (47%) of infected flies amont those which had been captured in shops.

5. Eggs of Hymenolepsis, enterobius, and diphyllobotrium are frequently found.

6. For the prevention of helminthoses, it is necessary to provide scrupulons protection of produce in shops.

7. It is likewise indespensable to dissiminate health education among medical personnel, trades people and the general population and to organize a day-to-day struggle against flies.

Descriptors

Disease/Solid Waste
Abstracts

No. DSW- 180

Author

R.S. Begbie and H. J. Gibson

Title

Occurrence of Typhoid-Paratyphoid

Bacilli in Sewage (Some Further Observations)

Reference

Journal of the British Medical

Doc. No. Contract No. Date issued

Association, Vol. II, 1930, p. 55

Abstract

1. A series of 57 specimens of sewage, which included samples from all main sewers of the city, has been examined with a view to the isolation of organisms of the enteric group.

2. By the use of three different methods of selective culture B. paratyphosus B Schottmuller was isolated from seven samples.

3. A simple routine method for isolating enteric organisms from the sewage is indicated.

4. A comparison has been made between the incidence of B. paratyphosus B infection in areas drained by sewers giving positive results, and in the city as a whole.

Descriptors

bacilli
carriers
B. paratyphosus B Schottmuller

sewage
enteric fever

paratyphoid
sewers

Disease/Solid Waste
Abstracts

No. DSW-181

Author

Frank M. Stead

Title

Public Health Aspects of Refuse Disposal

Reference

California's Health, V. 10, No. 20, April 30,

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| 1953, p. 153 | | |

Abstract

Flies are a triple threat to the community: (a) they are vectors of disease, (b) they threaten the cleanliness and wholesomeness of processed foods, and (c) they may become intensely annoying as pests. The presence of adult flies at the site of a refuse disposal operation is always a sanitary defect but becomes really serious when the fly population pressure becomes so high that "spillage" or "overflow" to the surrounding area occurs. When this takes place flies leave their "source point and go to an "attractant point" such as a restaurant, or home, where odors of food are present.

Rodents, like flies, have environmental specifications but they are not as exacting as those for flies. Stated simply, the two requirements are food and shelter. Exposed refuse usually furnishes both on a lavish scale. However, an open refuse dump seldom maintains rodents in the astronomic numbers associated with flies, and probably only a fraction of a community's rats can be attributed to its refuse disposal situation. An infested dump, for example, usually supports only a few hundred or at most a few thousand rats. The real public health concern arises from the fact that a refuse dump affords an almost ideal meeting place for field and domestic rodents.

There are two classes of air pollution related to refuse disposal. The first type results from the discharge into the air of smoke, dust, or odorous gases or vapors which are objectionable in themselves because of direct annoyance to people or damage to property or property values.

The transportation of refuse may constitute the most objectionable feature of the refuse disposal problem as far as the general public is concerned. Early morning noise from handling containers; dust, dirt, and papers blown from the truck or stirred up by the truck's passing; odors; unsightliness of truck contents and spillage of liquids or solids onto the street; and the convergence of large numbers

Descriptors

flies
air pollution
topography
long range planning

solid refuse
water pollution
planning principles

rodents
transportation nuisances
cost

Abstract (continued)

of heavy vehicles near the point of transfer, treatment, or disposal are all so offensive to a residential area that they should be given most serious consideration in the planning of the entire collection and disposal operation.

Landfill operations that raise the ground level in areas of flat terrain may result in interferrence with surface land drainage or in the creation of a "Chinese wall" obstructing view, both of which constitute a serious detriment to the environment of nearby residents.

Disease/Solid Waste
Abstracts

No. DSW-182

Author

Bernard Greenberg

Title Persistence of Bacteria in the Developmental stages of the Housefly. I. Survival of Enteric Pathogens in the Normal and Aseptically Reared Host.

Reference

Amer. J. of Tropical Medicine & Hygiene,

Doc. No. Contract No. Date issued

V. 8, 1959, p. 405

Abstract

One problem which drew many investigators dealt with the fate of pathogenic bacteria ingested by maggots in the breeding media. Faichnie(1) was one of the earliest to successfully pass typhoid and paratyphoid organisms in this way. His results are questionable, however, because of possible recontamination of flies emerging from unsterilized puparia. Graham-Smith (5) used sterilized media for the larvae and sterile food for the adults, but did not sterilize the eggs nor prevent aerial contamination of the larval medium. With complete asepsis, Tebbutt (10) recovered *Shigella dysenteriae* from pupae and adults in a small number of cases, but not S. *typhi*. Augmenting the difficulties attending these pioneer efforts was the unavailability of highly selective media for the routine isolation of enteric pathogens. More recently, Ostrolenk and Welch (9) demonstrated the presence of S. *enteritidis* in the emerging adult housefly.

SUMMARY

1. *Salmonella typhi* and *Shigella flexneri*, introduced into CSMA, a normally contaminated larval medium, were recovered infrequently from larvae and not at all from adult houseflies.

2. Under the same conditions, *Salmonella paratyphi* B was recovered more frequently from larvae and adults, though from a smaller percentage of adults than larvae.

3. S. *typhi*, when introduced into a sterilized larval medium, probably underwent some multiplication, whether or not maggots were present.

4. Each of the above species, including *Salmonella enteritidis*, when introduced into a sterilized larval medium, was routinely recovered from larvae and pupae of various ages. Mature maggots typically harbored about $10^7$ organisms. The counts of pupae from the second day until emergence was stabilized at $10^3$ to $10^4$. A small number of pupae were sterile or retained relatively few bacteria.

Descriptors

bacteria
host
S. *Typhi*
developmental stages
*Salmonella typhi*
S. *enteritidis*
housefly
*Shigella dysenteriae*
*Salmonella paratyphi* B

Abstract (continued)

5. An explanation based on interspecific competition in the larvale medium is suggested for the differential survival of these pathogens in fly stages breeding under natural conditions.

Disease/Solid Waste
Abstracts

No. DSW-183

Author

F.B. Bang and R.W. Glaser

Title

The Persistence of Poliomyelitis Virus in Flies

Reference

Amer. J. of Hyg., V.37, 1943, pp. 320

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | | |

Abstract

SUMMARY

Experiments with Theiler's mouse "poliomyelitis" and Armstrong's mouse-adapted human poliomyelitis show that the virus may be recovered from the adult fly only when the adult itself is infected by feeding. Theiler's virus may be recovered from Musca domestica as long as 12 days after infection, but the mouse-adapted human strain survived only 2 days in the housefly.

We were unable to recover the mouse-adapted Lansing virus from the 4 other species tested (Lucilia lepida (caesar), Muscina stabulans, Calliphora erythrocephala, and Sarcophaga hemorrhoidalis), while results with the mouse "poliomyelitis" in these species did not differ essentially from those obtained with Musca domestica.

Descriptors

survival
poliomyelitis

mouse "poliomyelitis"
flies

virus

**Disease/Solid Waste**
**Abstracts**

No. DSW-184

**Author**

John B. Gerberich

**Title** The Housefly(*Musca Domestica Linn.*), as a Vector of Salmonella Pullorum (Retteger) Bergy, The Agent of White Diarrhea of Chickens

**Reference**

The Ohio J. of Sci. 52(5):287, Sept. 1952

**Doc. No.** **Contract No.** **Date. issue**

**Abstract**

For many years flies have been suspected of being one of civilization's worst enemies in the transportation of bacterial organisms. Numerous publications (for historical account refer to Steinhaus, 1946) have appeared furnishing evidence that the adult housefly is a mechanical carrier of bacteria which are not only harmful to man but also to his domestic animals. Fewer studies are found relative to another phase of flies as vectors: that is, the fate of bacteria ingested by the larvae in relation to metamorphosis and the duration of the association. No study, to date has been found concerning the bacteria-fly-chicken association of white diarrhea.

SUMMARY OF DATA

The test bacterium was harbored by 181 out of 365 pupae free of contamination. One hundred and twenty-two of the 301 emerged flies disseminated S. *pullorum*.

Thirty-one chickens were allowed to feed on 37 previously infected houseflies. Four chickens, though treated similarly to the others, were separated from all flies and used as controls.

Five chickens produced evidence of S. *pullorum* from their fecal matter two days after the flies had been introduced into the cage but only one of the five produced such evidence for three consecutive days.

CONCLUSIONS

S. *pullorum* was disseminated by 40.53 percent of the experimental flies, 49.58 percent of the pupae harbored the test bacterium.

All 31 chickens produced S. *pullorum* in their fecal matter within ten days. In this study, S. pullorum was ingested by the larva of the housefly (maggot), survived the metamorphosis of the housefly and sufficiently established itself in the chicken, by a vector(the housefly), to be recovered from the chicken's feces. The above data establish the housefly, Musca domestica, as a vector of S. pullorum and thus increases the potential area of bacterial dissemination to that of the range of flight of the housefly.

**Descriptors**

housefly
*Salmonella* *Pullorum* (Retteger) Bergy
*Musca* *Domestica* *Linn*
white diarrhea
vector
chickens

**Disease/Solid Waste Abstracts**

No. DSW-185

Author

Enid W. Roberts

Title The Part Played by the Faeces and Vomit-Drop in the Transmission of Entamoeba Histolytica by Musca Domestica

Reference

Annals of Tropical Med. & Parasitology, V. 41, 1947, p. 129

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | | |

**Abstract**

The important role played by flies of the genus Musca in the transmission of both bacillary and amoebic dysentery is now well recognized, and it is generally agreed that, although flies belonging to other genera may sometimes be involved, the latters' share in spreading these disease is relatively insignificant.

A survey of the literature concerning bacillary dysentery shows that numerous investigators have proved the causal organism to be conveyed by the fly, not only in its faeces and, to a lesser extent, on its feet and body, but also-and probably most frequently - in its vomit-drop.

Discussion-Both the survey of the literature and the results of the experiments which we have carried out show that a fly, given access to infected material, may be responsible for the transmission of E. histolytica cysts in its faeces. Our experiments have shown that the period during which the fly can be regarded as a source of infection by this route may extend from five minutes to at least 31 hours after the initial infective feed - the limit of our observations - and that during this period cysts are excreted in considerable, though irregular, numbers. In the main, the observations recorded in this paper confirm those of earlier writers regarding the route taken by the ingested cysts which subsequently appear in the faeces, and it would seem that most, possibly all, of the E. histolytica cysts which enter the crop pass up the main food-canal, subsequent passage through the gut being completed by individual cysts at widely varying intervals.

It is now generally believed that, in urban areas, polluted drinking-water and food-handlers are the main sources of infection with amoebic dysentery (Craig, 1935; United States Public Health Service, 1936). In rural areas, however, particularly in the tropics, flies may prove of greater importance, for, under such conditions, not only

**Descriptors**

transmission
flies
B. dysenteriae (Shiga)
polluted drinking-water
amoebic dysentery
stools
Entamoeba Histolytica
faeces
cysts
food-handlers
rural areas
contamination
Musca Domestica
vomit-drop
urban areas
infection
sanitation

Abstract (continued)

do they tend to occur in greater numbers, but owing to lack of sanitation they have readier access to infected excreta and to human food-supplies. It is difficult to estimate the relative importance of the faecal drops and the vomit-drops as sources of infection, for, whereas the faeces undoubtedly contain a larger total of cysts, they are produced less frequently.

The results recorded in the present paper not only confirm the work of previous writers regarding the number of persistence of E. histolytica cysts in the faeces of flies having access to stools containing these organisms, but show that the cysts are also deposited in the vomit-drops; the number of cysts dispersed by flies and consequently the risk of contamination of fly-frequented surfaces are greater than was previously believed.

Disease/Solid Waste
Abstracts

No. DSW-186

Author

William Hanec

Title A Study of the Environmental Factors Affecting the Dispersion of House Flies (Musca domestica L.) in a Dairy Community ~~near Fort Whyte, Manitoba~~

Reference

The Canadian Entomologist, June 1956 V. 88

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| pp. 270 | | |

Abstract

SUMMARY AND CONCLUSIONS

Two releases of radioactive adult house flies were made in a dairy community during the summer of 1954 to determine (a) the effect of wind direction and wind-borne odors on dispersion of house flies; and (b) whether house flies disperse from one farm unit to another within the experimental area.

Adult house flies were tagged by feeding on radioactive phosphorus in aqueous solution sweetened with sucrose.

The results from the two releases indicate that (a) adult house flies orientate to wind-borne odors from farmyards, and (b) adult house flies migrate from one farmstead to another in appreciable numbers even in weather suboptimal for flight. This indicates the necessity of community rather than individual attempts to control this pest.

Descriptors

environmental factors
Dairy community
insecticides

dispersion
house fly
sanitation

Musca domestica L.
control

Disease/Solid Waste
Abstracts

No. DSW- 187

Author

K. D. Quarterman, W. Mathis, & J.W.Kilpatri

Title

Urban Fly Dispersal in the Area of Savannah, Georgia

Reference

J. of Economic Entomology, V. 47, No. 3

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| pp. 405 , 1954 | | |

Abstract

SUMMARY

Employing as marking agents a combination of radioactive chemicals incorporated in their food and a variety of dyes dusted on them before release, dispersal habits of the common spesies of flies in urban areas were studied.

Dispersal was rapid, continuous, and in all directions, the flies frequently passing in opposite directions to reach the sites at which they were trapped.

The flies concentrated in greater numbers in those areas most attractive to them. Large numbers of Callitroga macellaria and some of all species were recovered in vacant areas considerably removed from major fly-breeding sources.

Heavy fly-producing sources near a city contribute substantially to the city's fly population. Flies from dairies, an abattoir, and the city garbage dump located outside the city moved into all parts of the city and completely across it.

The majority of the marked house flies and Phaenicia spp. recovered were trapped within one-half mile of release points in these tests, although approximately one-third of the recaptured house flies were trapped more than a mile away in one test. Most of the Callitroga macellaria recovered were trapped between 1 and 4 miles from release points. House flies were recovered as far away as 7.6 miles, C. macellaria 7.2 miles miles, Phaenicia pallescens 5.0 miles, P. sericata 3.5 miles, Fannia pusio 3.5 miles, and Sarcophaga sueta 2.1 miles.

If the recovery of marked flies per trap were adjusted to equalize the traps in each 1-mile zone on the basis of land area served by each trap, the results would indicate that large numbers of flies moved into each 1-mile zone up to 4 miles or more from the release point.

Municipal fly control should be approached on a city-wide basis, and in some instances it may be desirable to include in such control operations the most important of the immediately outlying foci of high fly production.

Descriptors

dispersal habits
Callitroga macellaria
garbage dump
fly control
Sarcophaga sueta
flies
dairies
house flies
P. sericata
urban
abattoir
Phaenicia spp
Fannia pusio

**Disease/Solid Waste
Abstracts**

No. DSW- 188

Author

H. F. Schoof and R. E. Siverly

Title

Urban Fly Dispersion Studies with Special Reference to Movement Pattern of Musca Domestica

Reference

American Journal of Tropical Medicine and Hygiene, Vol. 3, pp 539-47, 1954

Doc. No. | Contract No. | Date. issued

Abstract

During recent years, the dispersal habits of flies have been the subject of study by a number of workers (Lindquist et al., 1951; Yates et al., 1952; Schoof et al., 1952; Schoof and Mail, 1953; and Quarterman, et al., unpubl.) These investigations established that the major portion of house fly dispersion in a community falls within one mile of the release point although movement can and does occur to distances of 2 to 7 miles. However, the distance that flies migrate is only one measure of their possible significance in disease transmission or in creating control problems some distance from their point of origin. A second, and perhaps more important, criterion is the manner in which the flies accomplish their movement to these distant sites. Does the fly arrive at an ultimate destination merely as a result of haphazard wandering or is its course of dispersion essentially a straight-line movement? This paper describes an attempt to gain an insight into this aspect of fly migration.

SUMMARY

At Phoenix, Arizona, approximately 147,000 radioactive Musca Domestica were liberated at a primary release site. For the 2-day period following, 15 fly traps were operated at 3 secondary sites 0.5 mile from the primary release point; the flies collected at each secondary site were then dusted with a characteristic dye, after which they were again liberated.

Collection stations within one mile of the primary release point indicated that, even though fly dispersion from that site followed a general random design, one sector of the recovery zone yielded a higher rate of recapture of radioactive

Descriptors

Musca domestica
dispersion
migration

Abstract (continued)

specimens than the remaining sectors.

A total of 104 radioactive and dyed M. domestica was retrieved. Fly movement from each of the 3 secondary release sites exhibited a random pattern. Reciprocal migration was manifested, certain specimens reversing their initial path of migration and returning to the general area of the primary release site.

The data indicate M. domestica to be essentially an insect of migrating habits. The house fly apparently spends the greater part of its existence in moving from site to site not only in search of breeding and feeding sources but also from an inherent instinct to wander.

Disease/Solid Waste
Abstracts

No. DSW-189

**Author**

Charles T. Brues

**Title**

The Relation of the Stable Fly (Stomoxys Calcitrans) to the Transmission of Infantile Paralysis (1)

**Reference**

Journal of Economic Entomology, Vol. 6,pp101-11

| Doc. No. | Contract No. | Date. issue |
|---|---|---|
| 1913 | | |

**Abstract**

. . . from previously made studies on the epidemiology of the disease, it appeared that many facts suggested some relation between insects and poliomyelitis.

Cases usually appear sporadically and very frequently in such a way as to render it very difficult to explain their origin on the basis of infection by personal contact. They also show a seasonal distribution very different from what might be expected of a contact infection. In winter the disease almost disappears, at the time when children are in closest association both in schools and elsewhere, but rapidly increases in prevalence during the summer, in late June and July, to a maximum in August, then rapidly decreases in September and October to the very slight winter incidence. Geographically, again, poliomyelitis does not follow the lines of densent population, but is on the contrary, quite generally typical or rural, or at least semi-rural districts. Thus in Massachusetts, in 1909, of the cities and towns where the disease occurred, the twenty-five most affected showed an incidence ranging from 5.26 to 1.12 per thousand (averaging 1.94), the average population of these places being 3,294; the twenty-five least affected showed an incidence of from .15 to .012 per thousand, (averaging .098) and had an average population of 32,217. Complete data concerning many other regions are difficult to collocate, but the greater rural incidence seems to be an established fact. The significance of this distribution becomes very great when we consider the fact that both domestic animals and the majority of insect species are most abundant over the same areas where poliomyelitis appears in its most extensive outbreaks.

**Descriptors**

stable
Stomoxys Calcitrans
transmission
infantile paralysis
virus
house flies
bedbugs
fleas
mosquitoes
lice

Abstract (continued)

. . . the summer abundance of poliomyelitis does not show any regular relation to rainfall or to general mosquito prevalence. . . . in none of the cases visited could we demonstrate the occurrence of a tick bite, either by examination or by questions . . .

After considering the various possibilities, it appeared probable that the common blood-sucking stable fly, Stomoxys calcitrans, might be implicated. Briefly, the reasons for suspecting a relation between Stomoxys and poliomyelitis were the following:

1. The blood-sucking habits of the adult fly suit it for the transfer of virus present in the blood.

2. The seasonal abundance of the fly is very closely correlated with the incidence of the disease, rising rapidly during the summer, and reaching a maximum in July and August; then slowly declining in September and October.

3. The geographical distribution of the fly is, so far as can be ascertained, wider, or at least co-extensive with that of poliomyelitis.

4. Stomoxys is distinctly more abundant under rural conditions, than in cities and thickly populated areas.

5. While the disease spreads over districts quickly and in a rather erratic way, it often appears to follow along lines of travel, and it is known that Stomoxys flies will often follow horses for long distances along highways.

6. In a surprisingly large number of cases, it appeared probable that the children affected had been in the habit of frequenting places where Stomoxys is particularly abundant, i.e., about stables, barnyards, etc.

During the summer of 1911, 88 cases of poliomyelitis were visited and studied both with regard to the individual histories of the patients and to the insect fauna of their environment. Stomoxys was found in every case, and often in exceptional abundance, while nothing appeared which would cast doubt upon a possible association of this insect with the disease.

At this point it should be mentioned that no fear was to be entertained that the healthy monkeys might become infected on account of their being introduced into the cage in which the poliomyelitis animals had been placed. Attempts to transfer the disease under conditions of far more intimate nature have been made, but have always given negative results.

Abstract (continued)

In all, twelve apparently healthy monkeys of a small Javan species were exposed to the flies in the manner described for the infected monkeys.

No results were apparent until two or three weeks after the experiment was well under way, and then in rather rapid succession six of the animals developed symptoms of poliomyelitis. In three, the disease appeared in a virulent form, resulting in death, while the other three experienced transient tremblings, diarrhoea, partial paralysis and recovery.

It thus appears to have been satisfactorily demonstrated that Stomoxys can transmit infantile paralysis from one monkey to another.

. . .: it has never been shown that virus derived from the mucosa can produce poliomyelitis by implantation on the mucosa of healthy monkeys.

Flexner, Howard and Clark in this country, and others abroad have worked to some extent with insects of certain kinds to see whether these could retain the virus of poliomyelitis in a virulent condition in their bodies for any length of time.

Positive results have been obtained in the case of house flies, bedbugs, and possibly with fleas, but only negative ones with several species of mosquitoes and lice.

The fact that Stomoxys does not bite children so very frequently suggests that perhaps poliomyelitis may possibly be regularly spread from some domestic animal which acts as a reservoir for the virus, . . .

On the other hand, the numerous mild cases which are usually regarded as abortive poliomyelitis may serve as reservoirs as well as the paralytic cases, and then the frequency with which Stomoxys bites might account for the incidence of the disease without any connections with animals. These are matters which will require much further study.

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(1) Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 62.

Disease/Solid Waste
Abstracts

No. DSW-190

Author
Brock C. Hampton

Title
Plague in the United States

Reference
Public Health Reports

| Doc. No. | Contract No. | Date issue |
|---|---|---|
| Vol. 55, No. 26 | | June 28, 19 |

Abstract

The first recorded appearance of plague in the United States, as well as on the North American continent, occurred in San Francisco, California, on March 6, 1900. Rat plague may exist in a city for some time without the development of the disease in human beings, as was found to be the case later in Seattle, Wash., and other cities.

In Los Angeles, Calif., in 1924-25: Rats were found to be numerous, infected ground squirrels were discovered there, and contact between the two species existed in many parts of the city. Furthermore, during the year there had been a virulent outbreak of plague in ground squirrels in San Luis Obispo County to the north of Los Angeles. Since 1924 and through 1939 only [illegible]5 cases of plague, with 6 deaths, have been reported in the United States, of which all but 4 cases and 1 death occurred in California.

From the time of the first appearance of plague in the United States in 1900 to January 1, 1940, there have been recorded 499 cases with 314 deaths.

With only 8 cases of human plague reported in the United States during the 10-year period 1930-1939, the disease in human beings in this country may be thought to have become merely a matter of academic interest; but when the situation is viewed in the light of the expanding areas in which plague-infected wild rodents and insect parasites have been found in recent years, the disease assumes significant public health importance and becomes a problem fraught with potential danger.

Plague infected rats were found in San Francisco during the first plague epidemic. Notwithstanding plague-preventive measures, the infection probably continued in these

Descriptors
- Plague
- Rats
- Ground squirrels
- Wild rodents
- Insect parasites
- Lice
- Ticks

Abstract (continued)

rodents in San Francisco and increased after the relaxation of suppressive measures to bring about a new human epidemic in 1907, following the earthquake and fire, which provided more favorable conditions of rodent and flea ecology.

To January 1, 1940, plague infection has been demonstrated in 14 species of ground squirrels, in red squirrels, tree squirrels, and flying squirrels, in wood rats, kangaroo rats, field mice, prairie dogs, chipmunks, marmots, and a cottontail rabbit in western United States, and in fleas, lice, and ticks from wild rodents. By inoculation tests of parasites, plague infection has been proved in approximately 100 pooled inoculations of fleas, 6 inoculations of lice, and 2 inoculations of ticks. In many instances flea infection was demonstrated while lice and ticks from the same groups of animal hosts were not found infected. On the other hand, one inoculation of ticks and one of lice produced plague infection in test animals when the fleas from the same hosts were not found infectious. Fleas and ticks have been found in the nests of the burrowing owl, which is a constant companion of the ground squirrel and is frequently a joint tenant in the burrows of this rodent. Wild rodent plague may spread unnoticed over great areas.

It is evident that farther spread of the infection eastward, through a rodent and human population of insufficient density to give rise to explosive epidemics, will eventually bring the disease within striking distance of the rat and human populations of large cities. Then, through a reversal of the original sequence of spread, the disease may become epidemic in any city near the approaching danger zone which has a sufficiently high population of rats and a sufficiently high flea index to provide favorable conditions for human infection.

It might appear to some persons that too much prominence has been accorded plague and too much effort devoted to it as a public health problem in this country; but it still holds our interest, because it scaled the barrier of quarantine, because of its persistence and gradual biological and geographic spread, and because of the difficulty in eradicating it entirely in vast areas of low biological density.

Disease/Solid Waste
Abstracts

No. DSW-191

Author

C. R. Eskey

Title

Recent Developments in our Knowledge of Plague Transmission

Reference

Public Health Reports V. 53 (1938), pp. 49

Doc. No. Contract No. Date issued

Abstract

Over 30 years have elapsed since the Indian Plague Commission demonstrated that fleas acted as the transmitting agents of bubonic plague. Since then, many investigators have attempted to implicate other blood-sucking parasites, such as bed bugs, lice, and ticks, as vectors of this desease. Thus far there is no evidence to indicate that any insect except the flea is of any importance in the natural dissemination of plague. Most of the work of the Indian Plague Commission was conducted with fleas of the genus Xenopsylla. The commission also investigated the ability of other species to transmit plague, some of which failed entierly to act as vectors.

The intensity of plague epidemics is not regulated by the totalnumber of fleas present on rats of a community but rather by the species of fleas with which the rats are infested. Insofar as is known, plague epidemics have never occurred in communities where fasciatus existed alone and were not associated with cheopis.

...Xenopsylla cheopis were found to be much more susceptible to plague infection than any of the other fleas tested.

Out attempts to transmit plague by feeding fleas on infected animals and then on healthy ones were entirely futile during the first 2 months of the experiments, although many of the fleas were found to be plague infected. It was not until the rat fleas, Xenopsylla cheopis, were included in the study that positive results were obtained.

During the last half of the work, 20 guinea pigs died of plague following the bites of fleas; 16 were infected by cheopis; 2 by fasciatus; and one each was infected by Diamanus montanus and Hoplopsyllus anomalus. With the exception of cheopis and Diamanus, there were not sufficient numbers of infected fleas of each species to justify definite conclusions regarding their abilities to transmit plague when feeding.

Descriptors

plague
bed bugs
vectors
Xenopsylla cheopis
transmission
lice
Xenopsylla
Ctenopsyllus segnis
fleas
ticks
Nosopsyllus fasciatus

Disease/Solid Waste
Abstracts

No. DSW-192

Author

Phyllis A. Clapham

Title

On Flies as Intermediate Hosts of Syngamus trachea

Reference

J. of Helminthology, Vol. XVII, No. 2

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| April 1939, pp. 61-64 | | |

Abstract

...Earthworms and snails form important reservoirs of infection, for the nematode larva can remain viable in these animsla for periods of several years. Syngamus trachea therefore occupies an interesting position among helminths in that it can complete its life history with or without an intermediate host.

Recently I have been able to demonstrate experimentally that a number of dipterous insects can...act as carriers. ...No one who has observed chickens can have failed to notice their efficiency in catching flies and the energy with which they pursue them and also their liking for the maggots. A batch of chickens will account for a very large number of them in the course of a day.

Of 12 maggots and 12 flies examined, all the maggots were infected, each with a single larva and 10 of the flies each again with a single larva. Feeding experiments to 12 chickens showed that most of the unexamined larvae and imagines must also have been infected for of 6 birds fed 20 maggots each, all developed "gapes" .... Of the half-dozen birds fed on 20 flies each, 5 became infected....

Experiments described are only preliminary and the beginning of a large scale group but they prove definitely that some flies both in the larval and in the imaginal states may act as intermediate hosts for Syngamus trachea.

...It is not an easy matter to parasitize chickens with worms of starling origin by direct passage yet by using an earthworm as intermediary the difficulties disappear and infection occurs readily.

Descriptors

flies
Syngamus trachea
starlings
hosts
parasite
chickens
earthworms
nematode
helminths

Disease/Solid Waste
Abstracts

No. DSW- 193

Author

J.E. Webb and H. M. Graham

Title

Observations on Some Filth Flies in the
Vicinity of Fort Churchill, Manitoba,
Canada, 1953-54

Reference

J. of Economic Entomology, Vol. 49. No. 5

| Doc. No. | Contract No. | Date. issue |
|---|---|---|
| 1956 , p. 595 | | |

Abstract

In this paper the term "filth flies" is used to signify their association with human waste, and also to indicate the exclusion of "biting flies."

Filth flies were not a nuisance or health problem in summer bivouacs, fishing camps, or other outdoor activities. At the post garbage disposal area located about one-half mile from Fort Churchill, two species of Calliphorids (C. cadaverina and Protophornia terraenovae) occurred in enormous numbers, and Musca domestica was found in considerable numbers in late July and August. None of these species ever occurred in noticeable numbers in the homes or around garbage stands at homes or messes located less than 1 mile from the post dump. A few of each of these three species were taken inside the two post messes but were not numerous enough to be a problem. Several miles from known breeding areas, large numbers of the two Calliphorids were collected in traps that were baited with human feces or with cooked meat. This however was not true with M. domestica, since only one specimen was collected in a trap baited with human feces located at a winter bivouac site 5 miles from Fort Churchill.

Baits used to attract flies in trap studies included human feces, cooked meat, milk-sugar mixture, and chopped fruits. Human feces attracted practically all species of flies that were attracted to the other baits and usually in much larger numbers.

The garrison mess at Fort Churchill was inspected at frequent intervals during both seasons for the presence of adult flies. The two Calliphorid species, P. terrae-novae and C. cadaverina, were more numberous in this mess in 1954 than in 1953. M. domestica did not appear in the mess until August during both seasons. M. domestica exercised the typical house fly habit of crawling over food and was seen around indoor-garbage cans, sweets, and various other foods.

Descriptors
filth flies
garbage disposal sites
C. cadaverina
human feces
troop bivouac sites
Protophornia terrae-novae
restaurants
Calliphorids
Musca domestica

## Abstract (continued)

Three species of flies believed to be the most important potential carriers of enteric diseases in the Fort Churchill area, namely *Musca domestica*, *Cynomyopsis cadaverina* and *Protophormia terrae-novae*, were studied in the laboratory during August and September of 1954 in order to determine whether they remained contaminated with organisms of *Salmonella typhosa* following exposure.

S. *typhosa* colonies were found to develop in the TSI agar slants from specimens of M. *domestica* up to 6 days following exposure and from specimens of P. *terrae-novae* up to 5 days following exposure. No recoveries were made from species of C. *cadaverina*; however this species was not studied as thoroughly as the others, due to difficulty of keeping it alive in captivity. Similar tests in 1953 did result in recovery of S. *typhosa* from C. *cadaverina* specimens 1 day following exposure.

*Protophormia terrae-novae* (R.D.) (Family Calliphoridae) was the most abundant species of filth fly encountered. It was observed to breed extensively in animal carcasses, garbage and to a lesser extent in human feces.

*Musca domestica* L. (Muscidae) - This species at present does not present a problem under field conditions as a breeder in human feces or as a pest at bivouac or camping activities. The entire population of the species appears to be associated with garbage disposal at Fort Churchill....

## SUMMARY

Twenty-seven species of filth flies are recorded from studies conducted in the vicinity of Fort Churchill, Manitoba, Canada in 1953 and 1954. Studies on biology, habits, abundance, seasonal occurrence and probable importance in human enteric disease transmission are reported for several species. *Musca domestica* and two species of Calliphorid flies C. *cadaverina* and P. *terrae-novae* were observed frequenting indoor messes in limited numbers. None were observed in any significant numbers at food preparation or food serving activities at troop bivouacs or outdoor camps. Human feces left on the surface of the ground at winter bivouac snow latrines, and also fresh feces, appeared to be a negligible source of filth flies of probably medical importance during the conduct of these studies.

Disease/Solid Waste
Abstracts

No. DSW- 194

Author
C. Gordon Hewitt

Title
The Housefly

Reference
Cambridge University Press

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | | 1914 |

Abstract

(Note: This abstract deals only with the fly as a carrier or possible transmitter of disease).

The author, quoting his own and Graham-Smith's work, describes the feeding habits and methods of the house fly, M. domestica Linn. The division of time between excrement and human food, internal and external contamination of the fly by pathogens and regurgitation of food onto new food and frequent defecation by the fly are recounted (p. 74ff). The author states that the rate of deposition and number of fecal and vomit spots is "highly significant in connection with the question of the bacterial contamination of food . . . ." (p. 82)

The author gives credit to Carl deGeer (1776) for early description of M. domestica's breeding habits and says "...he appears to be the first investigator who called attention to what I consider to be one of the most important factors in the development of the fly, namely, the process of fermentation occurring in the substance in which development is taking place," (p. 87). Warmth and humidity are emphasized as essential to fly reproduction. The author both observed and experimentally carried out fly breeding in "horse manure, cow-dung, flowl dung, human excrement . . . ." "... horse-manure is preferred by the female flies for oviposition to all other substances, and that it is in this substance that the majority of larvae are reared in nature; ..." (pgs. 89-90. "They were also reared on decaying vegetables thrown away as kitchen refuse and on such fruits as bananas, apricots, cherries, and peaches . . . and (in Canada) in germinating wheat . . . ." (p. 90). To these observations, he adds those of Orton (1910) on pig manure, spent hops and brewery waste as breeding places. However, fly species identification in the latter instances is questionable. Other observations of Prof. S. A. Forbes, A. H. Girault and J. J. Davis (1908,9) of the U.S., quoted by the author, demonstrate that in the absence of its favorite, horse manure, the house fly breeds in all manner of domestic, in rural refuse, abattoir wastes, and bakery wastes, (pp. 91-92).

Descriptors

Paine (1912) in Boston noted the enormous infestation of garbage pails by fly larvae, 1/5 of which on maturing proved to be M. domestica. Since the breeding and activity of M. Domestica is directly dependent upon temperature, "the greatest breeding activity takes place during the hottest months, July, August, and September," (p. 95). In special conditions of protection, breeding occurs throughout the year, as it does in the subtropics and tropics, (p. 96).

The Lesser House-fly (Fannia caniculoris L.) the latrine fly (F. scaloris Fab.), the stable fly (Stomoxys calcitrans L.), the blow flies,(Calliphora erythrocephola Meig and C. vomitorea L.), the Green bottle fly (Lucilia caesar L.), the cluster fly (Pollenia rudis Fab and Muscina Stabulans Fall.) and other flies are described as frequenting houses. For discussion of S. calcitrans in relation to disease, reference is made to Bruis, Rosman, & Sheppard, Anderson and Frost, the latter in respect to poliomyelitis. Metzmain (1914), Sawyer & Herms (1913), Schuberg and Boing (1913), are mentioned in regard to transmission of anthrax and streptococci by S. Calc. (p. 201).

Buchanen (1907) is reported to have recovered the bacillus of swine fever from blow-flies (p. 204). Muscina stabilous is reported (Banks, 1912) to have caused intestinal infection in a child and mycosis in a monkey (Carker and Blachstock, 1913) (p. 200). The habits of Musca Vetustissima Welk of slighting on human feces (makes it possible that . . . is such eye diseases as epidemic conjunctivitis and trachoma are transmitted by flies, this species would be incriminated,"(p. 213). Celand reported on the ability of this fly to transmit anthax. "...(The) habits (of musca domestica) render it a very potent factor in the dissemmination of disease by the mechanical transmission of the disease germs. These habits are the constnat frequenting and liking for substances used by man for food, on the one hand, and excremental products, purulant discharges, and moist surfaces on the other. Should these last contain pathogenic bacilli, the proboscis, body and legs of the fly are so densely covered setacaceous that a great opportunity occurs, with a maximum amount of probability for the transference of the organisma from the infected material to either particles of food or such moist places as the lips, eyes, etc," (p. 218) "...recent investigations (Graham-Smith 1909-1 , Torrey 1912, Cos, Lewis & Glynn 1912) would appear to indicate forcibly that the carriage of micro organisms in the digestive tract and infection therefrom is even more important than mechanical transference on the appendages and exterior of the body," (p. 219). "It should be pointed out that whereas in some of the disease the evidence widely adduced in support of transference of disease germs by flies is confirmed bacteriologically

**Disease/Solid Waste Abstracts**

No. DSW-195

**Author**

Wm. B. Herms (Revised by M.T. James)

**Title**

Medical Entomology

**Reference**

The Macmillan Co. New York, 1961, 5th Edition

**Doc. No.** | **Contract No.** | **Date issued**

**Abstract**

The "chain of infection" (arthropod-borne disease): "...There is a chain of events which leads to the successful transfer of an infection by an anthropod vector from one animal to another. This chain consists of several links, each more or less vulnerable and hence subject to repture, which could prevent successful transfer of the infection. The first link in the chain is the developmental cycle of the pathogen within the body of an appropriate host. This link may be broken by medicinal treatment.... The second link in the infection chain involves the vector, its access to infection, its feeding habits, its manner of ingesting food, structure of its mouth parts, etc.; the third link represents the progress of development of the pathogen...within the body stomach or other organs of the vector; the fourth link represents the manner in which the now infectious micro-organism leaves the body of the now-infectious vector and thereupon enters the body of the next susceptible animal, thus resulting in infection - specifically, it is the mechanism of infection, e.g., (1) simple contamination by means of germ-laden house flies or cockroaches coming in contact with food or milk, etc., (2) simple mechanical inoculation of antherax bacilli by means of contaminated horsefly mouth parts...(3) regurgitation of plague bacilli upon the skin by fleas....; (4) fecal contamination where trojpanosomes of Chagas' disease are deposited on the skin...(5) skin contimated with crushed tissue of infectious arthropods, (spotted fever)

The terminal link in the infectious chain is the successful completion of a cycle similar to that of the first link, but in the body of another host affecting the intervention of an arthropod vector." (p. 18)

Pathologic Conditions caused by arthropods (p. 19)

A. Arthropods as direct agents of disease or discomfort.
   1. Entomophobia (7)

**Descriptors**

entomology
arthropods
disease
intermediate hosts
vector
manure

Abstract (continued)

2. Annoyance & Blood Loss (Elderly people)
3. Accidental Injury to Sense Organs
4. Envenomization
5. Dermatosis
6. Myiasis and related infection
7. Allergy

B. Arthropods as Vectors or Intermediate Hosts.
  1. Mech. carriers
  2. Obligatory Vectors (agent in the cycle of pathogen-develop.)
  3. Intermediate Hosts (passive capacity)

Insury to eyes by bot fly larvae "often caused" (p. 19)...

A carpet beetle larva was taken from the ear of an elderly man...(p. 19)

The chigger mite, Trombicula (Eutrombicula) alfreddugesi as the common chigger of the U.S. - "often seen in the bases and root stocks of clumps of grass, in spagnum moss and under logs." (p. 515). More than a hundred hosts (T. alfred)-mammels, birds, amphibious, reptiles. The larval chigger feeds but once (but) requires up to a month for engorgement. It then drops to the ground and burrows.

Myiasis may be caused by larvae of the house fly and other flies (euteric or traumatic) p. 21).

Pulverized insect parts may cause allergic reactions (p. 21)

The author ascribes "filth disease" (typhoid fever, cholera, and amabiosis) to flies via human food (p. 21-2) and machan. fransius of yaws and certain eye infections by fleas (p. 22). "The eggs of halminth parasites, notable, pinworms, may also be disseminated."(p. 22). "It has been amply proved that coprophagous fly larvae (maggots) ...may transfer bacteria...thru the pupal stage to the mature fleas. In this manner, the infection of anthrax may be disseminated by fresh flies, bred in carcasses of animals that have died of this disease." (p. 22)

The author says that in connection with anthropods as intermediate hosts of parasitic worms "knowledge...is quite fragmentary" (p. 23-24). A fowl tapworm has the house fly, Musca domestica as intermediate host (p. 24). In regard to reservior animals, greater attention must be given to problems of forest sanitation in recreation areas". (p. 25)

"There are at least 70 species of mammals which may serve as possible reservoirs of plague (Stallybrass (8)).

(Chapter 15, p. 305) -"The House Fly and Its Relatives". "Many species of robust flies belonging to various families of Diptera are commonly found indoors. Some of these are an actual or potential menace to human health...." "These same flies, and others which have no relation to the transmission of pathological organs may be of further importance because of their annoyance and interference with human confort."..."The bionomics of the house fly and related formes of medical and sanitary importance have...been treated...by West (47) and a condensed account of the relation to disease, with an extensive list of citations, has been presented by Lindsay & Scudder (29).

Horse manure, cow, hog, chicken manure, human excrement are prime breeding media for house flies, but "other sources of breeding may be vastly more important

Abstract (continued)

than excrement. Smith (42) studying conditions in dairy barns in California concludes that the fly-breeding potential of these enormal amounts of organic wastes (chicken and cow manure, garbage, etc.) is far greater than it could possibly have been back in the horse-and-buggy days", and (personal communication) - "perhaps the greatest number of house flies I have seen came from lima bean waste in the field. I have seen nearly as great numbers from celery waste, tomato waste, etc." (p. 309-10). Brewers' waste is also a source of "enormous numbers of flies" (p. 310-11) when used as dairy animal food. Other food wastes become infested with maggots. Sludge in waste treatment operations is a breeding ground. "The Bureau of Vector Control of the Calif. State Dept. of Public Health has been making extensive studies of breeding media for the house fly and other species of nuisance fleas." (p. 312)

"Flies & Human Welfare" (p. 319) - Flies are public nuisances and "any outside influence that increases tension should, if possible, be eliminated.(p. 320). The author reviews the major sources or summaries on the fly as a carrier of disease agents. Watt & Lindsay (46) are quoted as having established the house fly as a vector of Shigellosis, but not of Salmonellosis. "Either the vectoring potentiality of the fly is low (for Salmonella) or the host qualification of man are unnatural, or both (Lindsay & Scudder (29). Satchell & Harrison (38) (indicate) "quite convincingly that wound-feeding flies, particularly M. domestica and M. Sorbens, are involved in the transmission of yaws in that area (Samoa)" (p. 324).

"In the U.S., Hippelates gnats are much more important than house flies in the transmission of that complex of bacillus-caused infections known as "pinkeye" and " "sore eye." The more serious trachoma of the near East is, according to Siniscal (41), a family disease resulting from poor sanitary products.... Lindsay & Scudder (29) believe that "if (Sinescals) conclusions are sound, flies would seem very unimportant as carriers during ordinary levels of the disease." (p. 325)

"...It is still unclear what role, if any, flies may play in the transmission of poliomyelitis to human beings...." (p. 326). "The conclusion that not only the house fly but also certain fresh flies and blow flies...can harbor the polio virus and, under proper circumstances, can transmit it by external contamination or by internal passage following ingestion, seems quite secure. However, proof is lacking. When, for example, a polio epidemic occurred in southern Texas in the test area where Watt & Lindsay were conducting their now classical experiments on Shigellosis, results of fly control in relation to the incidence of the disease were negative." (p. 326).

"Pipkin (32) believes that the external carriage of both trophozoite and cyst of E. histolytica is of no significance in the transmission of amebiasis except where sanitary conditions are generally ignored, but that transmission by way of the (fly) alimentary tract is important on a community basis, especially in backward areas" (p. 327).

In "The Sanitary & Medical Importance of Fleas", p. 408-426, the author relates flea-borne disease of man to the types of rodents commonly found about waste.

Abstract (continued)

Hippelates flies are thought to be related to the spread of conpuncturtis and yaws as well as bovina mastitis (p. 294-296). The larvae of the gnat feeds on "a great variety of decaying organic material including excrement...." (p. 296).

"The house mouse mite, allodermanyssus sanguineus (Hirst) is probably the most important dermanyssid mite from the standpoint of medical entomology. It is the only one that has definitely been incriminated in the transmission of a human disease....The house mouse, mus musculus, is the preferred host, but (it) will feed on rats and other rodents and will readily attach man. (p. 497). Rickettsiolpox is the disease (32).

Venomous and urticarial arthropods are discussed in Chapter 21, pp. 526-575, no data suggest significant association of such arthropods with solid waste.

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(7) Pomerantz, Charles, "Arthropods & Physhic Distrubances" Bull Entomol. Soc. Amer. 5:65-67, 1959.

(8) Stallybrass, Co. "The Principles of Epidemiology & The Process of Infection" London C. Routledge & Son, 696 pp., 1931

(47) West, L.S., The Housefly," Comstock Publ. Co, Ithaca, 1951, 584 pp.

(29) Lindsay, D.R. & Scudder, H.I., "Nonbiting Flies & Disease", Amer. Rev. Entomol, 1:323-46, 1956.

(46) Watt & Lindsay, "Diarrheal Disease Control Studies. I. Effect of Fly Control in a High Morbidity Area", U.S.P.H.S. in Publ. Health Rep 63: 1319-34, 1948.

(41) Siniscal, A.A. "The Trachoma Story", U.S.P.H.S, Pub. Health Rep. 70: 497-507, 1955

(32) Pipkin, A.C. "Experimental Studies on the role of filth flies in the transmission of endemoeba histolytic", Amer. J. Hyg. 49:255-75, 1949.

Disease/Solid Waste
Abstracts

No. DSW-196

Author

Ehlers, V.M. & Steel, E.W.

Title

Municipal & Rural Sanitation

Reference

McGraw-Hill, New York, 1958, 5th Edition

Doc. No. Contract No. Date issued

**Abstract**

Chapter (p. 7) (after Lumsden, USPHS) shows flies as typhoid fever transmitters. "Food contaminated by...flies...(has) been responsible for typhoid epidemics. Sporadic cases...usually...may be considered as due to a carrier or food contaminated by flies." (p. 8-9). In relation to dysentery, there is no specific mention of flies. "Fly-control campaigns...have had no effect in checking epidemics" (of poliomyelitis). (p. 10).

Arthropod-borne disease (insects, arachnids), (p. 12-13)
Typhus-(1) epidemic: body course
(2) endemic (murine): rat fleas & mites
Plague-rat fleas(primarily a disease of rats and other rodents). The fleas will feed on man in the absence of a rat.
Relapsing Fever-(tick-borne)-wild rodents
Molaria, yellow-fever, dengue, filariasis-mosquitoes
Tularemia-(sometimes by) ticks, blood-sucking flies
Arthropod-borne viral encephalitis-(reservoir possibly birds, bird mites): mosquitoes (US), ticks (Russia)

"More than 80 diseases are known to involve vertebrate animals as reserviors and are transmissible to humans." (pp. 13-14). Brucelosis, bovine TB, Q fever, Anthrax, leptospurosis, salmonellosis, tularemia, glanders, actinomycosis, tetanus are bacterial and rickettsial disease so transmissible (p. 14). Viral infections are rabis, paittacoses (ormthosis), encephalitis, food and mouth disease. (p. 14)
Mycotic disease: ringworm of cats and dogs (microsporum) and of cattle (trichophyston)
Parasitic infestations: trichinosis, pork tapeworm, beef tapeworm, hydatidosis and bread fish tapeworm of man (p. 14).

**Descriptors**

sanitation
dysentery
typhus
malaria
filariasis
brucellosis
anthrax
glanders
rabies
parasitic infestations

flies
piliomyelitis
plague
yellow fever
tularemia
boirnc TB
leptospirosis
actinomycosis
parttacoses

typhoid
arthropod
relapsing fever
dengue
encephalitis
Q fever
salmonellosis
tetanus
foot & mouth disease

Abstract (continued)

Q fever: "Human infection occurs primarily from the inhalation of rickettsia-laden particles that contaminate the environment of cattle lots, meat-packing and rendering plants, and wool-processing factories." (p. 14).
Anthrax: ("woolsorter's disease") occurrs among textile and wool factory workers. (90% of cases) man is infected thru skin abraisons, lungs or intestonal tract (p. 14).
Leptospirosis: Occurs among rats, other rodents, dogs, swine, cattle and occasionally other animals. Probably most human cases are caused by ingestion of food or water which has been contaminated with rat urine or by swimming in water holes to which animals have access". (p. 15).

Note: Abstracted only re solid-waste/human disease links possibilities.

**Disease/Solid Waste
Abstracts**

No. DSW-197

**Author**

William R. Horsfall

**Title**

Mosquitoes: Their Bionomics & Relation To Disease

**Reference**

The Ronald Press Co. New York, 1955

| Doc. No. | Contract No. | Date. issued |
|---|---|---|
| | | |

**Abstract**

(Abstracted only in relation to possible association of moxquitoes to solid waste).

Oviposition: (p. 27). "Water must be present as surface moisture or as a collection before any species will oviposit."
Anopheles: Oviposition-all species deposit eggs singly on water free from wave action (p. 51). Reservoir for filarids: W. bancrofti and others, Plasmodium species (p. 52) Transmission of plasmodia causing malaria is dependent on having one or several anophelines in the reservoir (p. 53). "The matter of effective transmission is more than a combination of proper mosquitoes and humans in the same area as Ross (1903) said, "In order to produce malaria it is necessary not only that Anopheles exist but that they are numerous"...One of the weakest links in the transmission chain and the one that especially limits the reservoir significantly of a mosquito is the requirement that it must feed repeatedly on man." (p. 54). (p. 8,9)."Eggs of mosquitoes may be found at the proper time of year in water or among debris on the ground...in domestic cavities and containers." Incubation interval is always a matter of a few days...species that oviposit on water may require a few hours to a few days at most for hatching." (p. 9)..."Abundance of mosquitoes within an area is determined by numerous interacting features of environment. Water is essential, and collection of transient water are especially productive (p. 7). Broad acreages of poorly drained land and serially inundated areas yield maximum populations" (p. 7)... Streams and pools polluted by animal and various other wastes may yield hordes of mosquitoes." (p. 7). "Malaria first loses its hyperendemicity, then its endemicity, then it becomes sporadic and dependent on imported sources before it finally disappears. (p. 56).

**Descriptors**

mosquitoes
reservoir
malaria
bionomics
filarids
water
disease
plasmodia

Note: Except for the notation of "domestic containers" (above) a component of solid waste and the separate general observation of mosquito larvae in discarded containers holding water, no implication for human disease/solid waste is contained in this book.

Disease/Solid Waste
Abstracts

No. DSW-198

| | | |
|---|---|---|
| Author | | |
| R. P. Strong | | |
| Title | | |
| Stitt's Diag. Prev. & Treatment of | | |
| Tropical Diseases | | |
| Reference | | |
| The Blakiston Co. Phila. Vol. I, 6th Edit. | | |
| Doc. No. | Contract No. | Date issued |
| 1942 | | |

**Abstract**

The Leishmaniases-Transmission: (Kala-azar) - insect host of L. domovani-sandfly-genus phlebotomus have been suggested and experimentally tested for transmission of the disease without thoroughly supportive evidence (p. 248-254)...Cutaneous Lushmaniesis (oriental sore)-direct human contact"greatly probable". The sandfly also demonstrated as a host (p. 299-303).

Tropical relapsing fevers-Spirochacta (Borrelia)-agent. Hosts-lice, ticks, louse: Pediculus huncanus, Ticks: Ormithodorous: O. turicata in U.S. Southwest & O. hermai in Calif. Rats reported to become infected by the ticks. (pp. 331-344). In Calif. O. hermai is found only at elevations of 5000-8000 ft (eg. Big Bear & Tahoe Lakes) In Calif. O. hermusi is typically a parasite of rodents. (p. 342).
Rat Bite Fever: Relapsing fever if bitten by rat-agent: "Sperilium moraus-muris". In nature rodents act as a reservoir. Various rats (e.g., mus noroegicus) also became infected (p. 380).
Yaws-agent: Treponema pirtanue; transmission: direct contact, probably also by hippelates flies.
Dysentery (p. 444), Protozoal, heminthic and bacillary classification.
Protozoal:
Balantidial-agent: ciliated unfusorium Balantidium coli-("much rarer info than with amoabic or bacillary dysentery).-Texas, N.&S. Carolina. The parasite is common in the pig. Cysts transferred to humans thru handlnng of infected GI tract of pigs, eating raw sawsage or from pig manure (p. 445). Cysts survive for weeks in moist feces. (p. 452).
Coccidiosis-Human infection with Isospora hominis. Not definitely established as a pattogen of man (p. 458).

**Descriptors**

disease
relapsing fevers
dysentery
tularemia
Leishmaniases
rat bite fever
cholera
undulant fever
insect host
yaws
plague

Abstract (continued)

Helminthic-These species of flukes, or trematodes, of the genus Schistosoma, are parasetic in the vencus system of man. Eggs are extruded thru organs, especially bowel and bladder. S. mansoni & S. papomium give use to intestional schistosome icsis and dysentery. S. haematobrum gives rise to hematuria. The snail is the host (see vol. II, p. 1396).
Intestinal Flagelletes-Trichomones: T. hominis (bowel), T. baccalis and T. vagenitis (p. 463) commensols-harmless. (p. 466).
Amoebiasis-Endamoeba histolytica.-cysts are formed and passed in the stool. Cysts resistant to chlorination (p. 491) mode of infection & spread-(1) by contaminated food or water by feces containing cysts (2) droppings of flies or cockroaches (3) human excretion (as fertilizer), (4) spread by lower animals, as monkeys and rats (p. 491) epidemics are usually caused by polluted water supplies (p. 493). Flies may also give rise to local epidemics (Craig-El Paso, Texas-troops). "The cysts can readily pass unaltered thru the intestine of the fly". (p. 493).
E. histolytic has been found in rats in the U.S. (p. 494) (Lynch-1915). Cross infection between rats and man is apparently possible (Tsuchiya-1939).
Bacillary Dysentary (p. 541-589)-"...outbreaks are particularly influenced by hygienic conditions and the presence of flies (p. 544)-Shiga divided the dysentery bacteria into 5 types general shigella. The author gives 2: S. dysenterie and S. paradys. The organism resembles typhoid in its mode of spread (p. 551) being ingested in food and water contaminated by feces of cases or by carriers "Fly transmission is usually of much greater importance...(especially) in the tropics ...". (p. 552).
Cholera-The role flies play in the spread of this disease is discounted in comparison with other modes (p. 604) Water-borne and carrier-transmitted cholera are in part "Flies may plan an important part in spreading the infection mech...transmission by flies this way seems to have been important in an outbreak in shigella in 1937 (p. 610).
Plague-agent: Pasteurella pests.-causes hemorrhagic septicemia" Plague's primarily an epizootic of rats but other rodents can be the source of human infection (p. 661) chronic plague can exist in rats and serves as a reservoir (p. 666) The rat flea is the agent of transmission (p. 667). Xemopsylla cheepis, the Indian rat flea, is the species primarily responsible for transmission. It infests R. norwegicus as well as the Indian black rat (Rattus rattus). The latter usually receives its infection from the former (p. 670) and, as house rats, cause infection of man.
Tularemia-Natural infections occur in wild rodents, especially rabbits, Calif. ground squirrel, wild rats, and meadow mice. The disease is transmitted and matured in animals by Dermacentor andersoni (woodtick); chrysops discalis (horse fly or deer fly), rabbit tick and probably by lice. Experimental transmission by animal fleas has been effected (p.714-5). Wayson (1714) considers the stable fly (Stomoxys calcitrums) and M. domestica as possible vectors (mechan). (p. 715) Rats are only slightly suscept (p. 716).
Undulant Fever-no vector associated with solid wastes are considered in this chapter (p. 739-812).

Disease/Solid Waste
Abstracts

No. DSW-199

Author

R. B. Ainsworth

Title

The House-Fly as a Disease Carrier

Reference

J. of the Royal Army Med. Corps. Vol. XII,

| Doc. No. | Contract No. | Date. issued |
|---|---|---|
| May, 1909. No. 5. p. 34 | | |

Abstract

I readily admit that the observations recorded and the arguments advanced in this paper are open to the objection that they affort but scanty data upon which to base so important a conclusion that the house-fly is frequently the intermediary and probably by far the most common intermediary, in the propagation of that bete noire of Indian sanitarians, enteric fever. Nevertheless, scanty though these data undoubtedly are, rough though the methods exployed may be, and brief the period over which the observations extend, there is an isochronism shown in the appended charts between the advent of the house-fly in Poona and the seasonal prevalence of enteric fever, which is highly significant and at least suggests that a prima facie case has been established for further investigation.

I...will content myself by saying that there is so far no reliable evidence that domestic animals have anything to do with the propagation of enteric fever, except indirectly, e.g, horse dung as a breeding medium for flies....

...Out of ninety-two cases of enteric fever collected by me in Poona during the first ten months of 1908, no less than forty were genuine attacks in natives, from whose blood in many instances I isolated pure cultures of Bacillus typhosus.

Attention has repeatedly been called to the prevalence of flies concurrently with epidemic outbreaks of enteric, and notably by Aldridge (Annual Sanitary Report, Eastern Command, 1904). Similarly, Dr. Snell, M.O.H., Coventry, in 1906, showed that 70 percent of the cases of infantile diarrhoea occurred in the north-east part of his district, close to a large collection of refuse where flies swarmed.

In Poona and Kirkee enteric fever begins in July, reaches its maximum in August, maintains a high level in September, dies down in October, and nearly disappears in November and December. This is a very striking fact, and points unmistakably to a regularly recurrent case. ...Analyses, both chemical and bacteriological, exonerate

Descriptors

infantile diarrhoea
house fly
enteric fever

Abstract (continued)

the water....the monsoon breaks invariably in the middle of June, and enteric does not become epidemic until August. But heat and moisture, combined with suitable breeding media, will of a certainty produce flies.

Granted that I only had the opportunity of carrying on my observations for one season, yet the coincidence is so striking that, as I have already said, there appear to be ample grounds for further enquiry. Add to this tabulated statement-the result of careful experiment--the general observations made by many medical officers that fly prevalence means probably an outbreak of enteric in the near future, and I think that many will arrive at the conclusion that the fly is the intermediary between the "bacillus carrier" on the one hand and the susceptible individual upon the other.

Charts Nos. 17 and 20 ...support Dr. Snell's conclusions above quoted, and to to prove that this exceedingly prevalent and fatal disease is probably fly-borne.

It seems to me that enteric prevention naturally groups itself under five headings, viz:-

(1) Isolation of the human carrier, failing
(2) Elimination of the bacillus by means of some drug as yet undiscovered.
(3) Rendering excreta innocuous, by disinfection, water-carriage and similar sanitary measûres.
(4) The establishment of immunity
(5) The destruction of the go-between, to wit, the fly.

Disease/Solid Waste
Abstracts

No. DSW-200

Author

Gurnham, C. Fred

Title

Principles of Industrial Waste Treatment

John Wiley & Sons, New York

Reference

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| | | 1955 |

Abstract

Contamination of streams with disease-producing bacteria presents a serious hazard to public health if the stream is used for water supply, for bathing or other recreational purposes, or as a habitat for food fish. Bacterial contamination is most often caused by untreated or inadequately treated human wastes in municipal sewage. It is not a characteristic of industrial wastes, with the possible exception of some tannery and packinghouse wastes, and will not be discussed more than breifly in this book. Another hazard to the public results from toxic wastes like acids, metal salts, and radioactive materials. Injuries to people by such discharges have fortunately been rare, but the killing of farm animals is frequent enough to indicate the danger. Little is known of the possible cumulative action of metal salts and similar poisons that may lead to general ill health and debility without becoming abruptly apparent by causing death.

Solid wastes frequently enter the liquid waste stream either by accident or by design, and so become the problem of the industrial waste engineer. Typical of such water-borne solids are sawdust, mineral fines like the dust from crushing coal, and waste or scrap material from canneries. These solids should be kept out of the liquid wastes as completely as possible, since their removal from the plant area and their ultimate disposal are generally easier in their original solid form.

Another public health hazard caused by industrial waste is pollution with toxic materials, which may enter a municipal water supply or may be harmful to people using the stream for recreational purposes; these toxic substances include acids, alkalies, and specific poisons like the cyanides or heavy metal salts.

Danger to public health from polluted waters comes not only from direct use of the water but also from food fish that have lived in the polluted stream. Many poisonous substances are absorbed by fish, often in concentrated form; hence the eating of fish from polluted waters may be even more hazardous then drinking the water. Shellfish, especially, frequently thrive in contaminated water and thereby become toxic to human beings.

Descriptors

public health
wastes
industrial wastes
toxic wastes
toxic materials
cyanides
metal salts
bacteria
pollution
chlorides

settleable solids
precipitates
septic conditions
scums
hydrocarbon oils
digesters
insoluble residues
activated sludge
detergents
self-purification

frothing
biological
acidity
alkalinity
phenols
formaldehyde
antiseptic
primary treatment
sludge digestion
salvage

(Descriptors continued on Page 11)

## Abstract (continued)

Discharge of toxic wastes underground instead of into surface streams is a suitable disposal means under certain conditions; however, if there is any possibility of later withdrawal of the subterranean water for domestic use, the hazard may be intensified. Danger also exists if the polluted underground aquifer reaches the surface during its normal course of flow. With underground disposal, the hazards are postponed, but a reservoir of waste is accumulated, and seepage of toxic materials may persist long after discharge of wastes has been stopped. Cyanides, chromates, and heavy-metal ions have been especially troublesome in groundwaters after pollution by wastes from metal-fishing industries.

Hazard to the public other than danger to health is less common, but is illustrated by danger of fire from floating oils, solvents, or flammable solids. Severe fires have occurred on the surface of streams heavily polluted with petroleum products, either by accidental spills or gradual accumulation from small discharges.

Deposition of solids in sewers and sewer catch basins is an inevitable result of the discharge of industrial effluents too high in settleable solids and precipitates Settled solids cut down sewer capacity, and may lead to flooding and overflowing, with resulting unsanitary conditions. Coarse solids like paper, cloth, garbage, and sticks are especially troublesome, as they may clog or injure pumps, valves, and sludge-moving mechanisms at the treatment plant. Discharge of such coarse materials into a municipal sewer should not be permitted under any conditions.

Stoppage of small sewers frequently occurs because of grease accumulations. The quantity of grease normally present in domestic wastes is not troublesome, but restaurant and institutional kitchens often discharge greasy wastes that form deposits on sewer walls. Certain industries are also offenders in this respect unless adequate grease removal is provided by pretreatment of wastes before discharge; chief among these industries are meat packers and commercial laundries. Grease that reaches the treatment plant is a source of trouble in clogging equipment and in retarding the desired chemical and bacterial activity.

Industrial wastes with high concentrations of settleable solids place an added burden on the sewage treatment plant, or, what is worse, the solids may settle in sewage-collecting systems, causing flow reduction and septic conditions. Excessive settleable solids reaching the treatment plant result in overloading the screens, grit chambers, settling tanks, and sludge-handling mechanisms. Disposal of solids is also more difficult because of the greater volume, which may require an increase in the capacity of sludge digestion tanks, filters, drying beds, and sludge-transportation equipment.

Industrial waste solids are objectionable, not only because they add to the total solid loading, but also because they differ from normal sewage solids in their characteristics. Coarse and floating solids, such as hair, feathers, and rags, occur in certain industrial wastes, and cannot be handled by conventional sewage processing equipment. Oils and greases are troublesome because they cause sludges and floating scums that do not settle, drain, or dry properly. Hydrocarbon oils are not digestible, and form heavy scum layers that overload digesters and interfere with the digestion of other organic substances.

Specific industrial wastes cause unusual problems in the operation of a municipal sewage treatment plant; for example, iron wastes often precipitate insoluble residues that clog equipment. Air diffusers, used in the aeration of

Abstract (continued)

activated sludge, may be rendered inoperable by iron pickle wastes, and restoration of their usefulness by cleaning is difficult and never fully satisfactory. Under extremely high iron loadings, such as occurred at Worchester, Massachusetts, during World War II, trickling filter beds become completely clogged and useless. Discharge of synthetic detergents into municipal sewage has caused frothing troubles in aeration tanks, with froth blankets several feet thick reported in severe cases. Since this sewage froth may be carried by wind into inhabited areas, the hazard to public health is obvious (2).

Many sewage treatment processes are based on biological and bacterial action, and may be retarded or stopped entirely by the presence of certain industrial waste constituents. Extremes of acidity or alkalinity have this effect, as does the presence of heavy-metal salts, cyanides, phenols, formaldehyde, and other specific chemicals.

A restriction of 100 ppm of any antiseptic substance and of 5 ppb (parts per billion) of phenols is included. Because of the large number of metal-working and metal-finishing plants in the Allegheny County area, restrictions are specific with respect to certain metals, as follows: total iron, 5 ppm; copper 3 ppm in sewage that will receive only primary treatment and no sludge digestion, 1 ppm otherwise; chromium, 5 ppm in sewage intended for primary treatment only, 3 ppm for secondary treatment; cyanide, 2 ppm in all sewages. Most metals have not been studied sufficiently to establish definite permissible limits; hence there is wide variation in municipal ordinances with respect to nickel, zinc, and other heavy metals.)

No reasonable means for removing chlorides from a waste is known, and once chlorides enter a stream they are not removed by any natural self-purification processes. Any answer to the chloride waste problem must be based on salvage of the waste or on its disposal to some site where it cannot enter potable water supplies.

Disposal of brines on land is not a satisfactory technique since this does nothing to remove chlorides, which will eventually leach out to a stream or underground water course. Leaching occurs whether the brines are dispersed over a large land area or are ponded for evaporation. On agricultural lands chloride wastes destroy crops and render the land unfit for cultivation until the salt has been washed out-into some stream! Underground discharge into a brine aquifer or other nonpotable water stratum is being practiced, but for many industries disposal of brine wastes remains one of the major unsolved problems.

Removal of BOD from an industrial waste is usually based on aerobic biological oxidation of organic matter. First, however, a substantial portion of the BOD load can frequently be removed by the simpler and less expensive operations of sedimentation or screening. Suspended BOD-carrying matter is thereby removed in solid form, and can be disposed of by burial, incineration, or anaerobic digestion.

BOD in soluble form is usually destroyed by oxidation processes in the treatment plant. Chemical oxidation is unreasonably expensive except for very dilute wastes, where chlorine or ozone can be utilized. It is more economical to subject the organic matter to biological oxidation by activated sludge or trickling filters.

Anaerobic biological decomposition is another technique for destroying the soluble portion of BOD in many wastes, as well as for disposing of the insoluble BOD substances separated as sludge or screenings. Anaerobic decomposition or digestion of sludges is a widely used process in sewage and industrial waste treatment; anaerobic decomposition or fermentation of whole wastes is a more recent development that is finding application in the treatment of meat-packing effluents and other organic industrial wastes.

## Abstract (continued)

Inorganic cyanide wastes have their principal origin in the metal-finishing industries, where cyanides are used as molten salt baths for heat-treating metals, and as solutions for electroplating. Organic cyanide wastes result from the manufacture of certain plastics and synthetic fibers; these have become important since about 1948, and the industry is expanding rapidly.

Only low concentrations of cyanide should be permitted in any stream, and many pollution control agencies insist that no cyanide compounds shall be discharged. Perhaps 0.1 ppm of cyanide (as HCN or CN-ion) could be tolerated in almost any stream, but the principal hazard comes from unanticipated or accidental discharges of greater strength. In sewer systems somewhat higher concentrations can be tolerated, the principal limitations being hazard to sewerage system personnel and interference with biological treatment processes at the plant.

Numerous techniques are available for treating wastes containing cyanides, and several of these have been utilized on the wastes from large industrial plants. The most popular technique since about 1946 has been chlorination of cyanide wastes under alkaline conditions, thereby oxidizing the cyanide first to cyanate, which is far less toxic, and finally to such harmless compounds as carbon dioxide and nitrogen or ammonium salts.

In the manufacture of paper pulp from wood by the sulfate and soda process, spent cook liquors would be a major source of stream pollution if they were not recovered. The recovery process involves evaporation of spent liquor to a concentration where it can be burned. Incineration then destroys the organic material, leaving the basic chemicals in usable or easily recovered form.

In the brewing and distilling industries, spent grains after fermentation are almost universally recovered by fine screens and are processed for use as cattle food. This by-product is an essential part of the industry's over-all economy. Recovery of still residues, known as "distillers' slops" or "still bottoms," is also practiced; these are concentrated by evaporation to the point where they can be utilized in the manufacture of stock food or fertilizer.

Batch sedimentation tanks, operating on the fill-and-draw principle, are used in small industrial installations, but larger plants connomly prefer continuous-flow units with continuous or intermittent removal of sludge. For a continuous-flow sedimentation tank, the elemental design factors to be specified include surface area, depth, ratio of length to width, and sludge-collecting facilities. Detention time, overflow rate, and liquid velocity are governed by these simpler factors.

Vertical Flow Sedimentation - Vertical or upward flow clarifiers have been introduced in recent years; upward flow near the overflow weir is, of course, a feature of all settling tanks. Upward movement of liquid is opposed to the settling motion of solid particles, and so tends to retard sedimentation; however with proper design and good operating conditions, liquid velocity is too slight to be of significance. More important, liquid velocity can be made several times less than in tanks of conventional flow pattern, because the cross section of flow area is larger; that is, the plan area of a clarifier is larger than its vertical cross section. Increased overflow weir length is also possible in vertical flow units because the entire tank periphery can be utilized. Maintenance of a deep sludge blanket, through which the liquid moves upward, resembles filtration in a

Abstract (continued)

fluidized bed rather than simple settling, but sedimentation principles apply to holding the sludge blanket in place

Centrifugal Sedimentation - Separation of suspended matter by sedimentation can be accelerated by use of centrifugal force instead of gravity, but applications of this principle in waste disposal are rare. Both the capital cost and the power consumption of centrifugal equipment are high in comparison with gravity settling units; use of centrifuges is practical only when space is too limited for settling basins of adequate capacity, or when centrifugation possesses special advantages. Slow-settling suspensions that require unreasonably long detention periods in conventional clarifiers, especially wastes that might become septic during this period, suggest the use of centrifugual equipment. Centrifugals have been used, for example, in treating petroleum wastes, to expedite and improve the efficiency of separation and recovery of oil. Centrifuges are also used in the concentration and partial drying of solids separated by screening or settling, such as distillers' grains or recoverable chemical sludges. Sludge from tannery waste, for example, is being recovered by centrifugal equipment in a plant at Ridgway, Pennsylvania. In the countercurrent solvent extraction of phenol from coke industry wastes, the centrifugal principle may be employed to hasten liquid separations, thereby permitting an increased number of extraction contacts.

Oils and greases of lower specific gravity than water tend to rise to the liquid surface, just as heavy insoluble particles sink during the sedimentation operation. Such oils occur in all liquid effluents from petroleum production and refining, and in wastes from many other industries, including metal finishing (protective oils removed frommetal surfaces prior to electroplating, enameling, or painting, and solvents from coating operations), wool scouring (naturally occurring wool grease), meat packing, and other food and chemical industries Frequently the oils recovered by waste settling are valuable materials, and are returned to the plant process or specially treated for recovery as by-products. When they are of little value, they are usually burned, sometimes as useful fuel and otherwise only as a means of disposal.

Several techniques have been utilized to break emulsions in industrial effluents; the choice for any particular waste should be based on laboratory trials and on consideration of the costs involved. Application of heat is often helpful, both because it reduces viscosity and hence accelerates settling rates, and because it causes chemical and physical changes in the colloidal system. Distillation has been employed on some particular resistant emulsions. Adjustment of pH may destroy the protective colloid and permit settling; the seme result can sometimes be obtained by aeration or chemical coagulation. Centrifuging is a means of magnifying sedimentation forces, and can be employed alone or in conjunction with heating or chemical additions. Filtration with diatomaceous earth or other filter aid is usually a workable technique; and other operations and processes have been used under special conditions. Plain sedimentation is the least expensive separation technique. Hence, wherever possible, we should treat emulsions to render them settleable rather than resort to the other techniques like distillation, filtration, and adsorption.

Abstract (continued)

Oily and greasy wastes from various industrial sources can be handled in gravity separators like those of the petroleum industry. The water-gas industry and other fuel-gas manufacturing operations produce wastes containing tars; these can be recovered to a considerable degree in such units unless the tars are emulsified, when special additional processing may be necessary. Meat-packing wastes are practically always passed through grease traps, or settling tanks equipped for grease removal, ahead of other processing units, both for the recovery of valuable by-products and because these heavy greases clog or inactivate subsequent process units. Treatment processes such as trickling filters and activated sludge are especially susceptible to this interference. The same is true of tannery wastes, since these have a high grease content that should be removed at as early a stage of treatment as possible. Scour liquors from raw wool processing can yield a marketable grease by treatment with acid or other chemicals, and separation by settling.

Flotation is a modification of sedimentation where air bubbles are introduced or formed in a waste containing suspended matter, and are caused to adhere to the solid particles; so when quiet conditions are provided, the solids settle upward, or are floated, by the lifting action of the gas bubbles. This technique, originally developed in the mineral beneficiation industries, is finding numerous applications in sewage and industrial waste treatment (11).

Filtration is defined as the mechanical separation of suspended solids from a liquid by passing the liquid through a porous medium that retains the solids on its upstream face. The operation serves the same purpose as sedimentation, although the technique is different. Filtration is usually more expensive than settling, but the equipment requires less space, the operation is more rapid, and the solids recovered are more nearly dry.

The basic requirements of a filtration device are a porous medium such as a sand bed, proous stone, metal screen, paper, or cloth; a support for the porous medium unless it is self-supporting; a supply of feed liquor under pressure, or, alternatively, a means of withdrawing filtered liquid by vacuum; space for accumulation of solids as filter cake; provision for removal of filtrate; and sometimes a means for washing the deposited solids.

Drying of a solid material involves reduction of its water content by vaporization of the water into air or other atmosphere. The heat required for vaporization is usually provided by the incoming air, but in special types of drying, auxiliary heat is furnished by heated surfaces, radiant energy, or other means. The word "drying" is popularly employed in a much broader sense than is indicated by the definition, and includes the removal of water by almost any technique, even by mechanical dewatering.

Municipal sewage sludge, either from primary sedimentation or from digestion tanks, is frequently dried for use as fertilizer. The operations prior to drying usually include mechanical dewatering on sand beds or rotary filters. The drying itself can be completed on sand beds, or can be done more rapidly by use of artificial heat, in rotary driers. Among the industrial wastes dried in this manner are vacuum-filtered sludge from meat-packing wastes treated by the Hormel process, clarified and concentrated distillery slop from the Overhold process, and cannery wastes.

Most organic waste sludges can be burned with little or no auxiliary fuel after they have been partially dewatered by filtration or screening. Additional

Abstract (continued)

dewatering by drying reduces further the heat requirements for volatilization of residual moisture, and hence permits incineration of sludges containing a smaller fraction of combustible matter.

Magnesiabase sulfite cook liquors also are evaporated to 40 or 50 percent solids, and burned for recovery of heat and chemicals, although the more common calcium- or lime-base sulfite liquors cannot be processed satisfactorily in this manner.

Arbogast (8) has reported on incineration of wastes from the Lederle Laboratories Division of the American Cyanamid Company. These wastes include rubbish, garbage, manures, valueless by-products from plant operations, and sludges from sewage and waste treatment operations.

The purpose of coagulation is removal of finely divided suspended solids or colloidal material from the waste liquid. These contaminants cannot be separated by sedimentation alone except by use of unreasonably long detention periods; truly colloidal particles cannot be removed at all by settling. If these suspended pollutants are organic, they can often by oxidized by biological means, as on the trickling filter; biochemical oxidation, however, if slower for suspended matter than for dissolved organic contaminants. If the quantity of insoluble organic matter is large, bio-oxidation equipment must be increased in size to care for this added duty; it is usually more economical to remove the greater part of such matter by chemical coagulation instead of in a trickling filter or activated sludge tank.

Flocculation is the formation of clumps or flocs of suspended solids by agglomeration of smaller suspended particles. Most chemical precipitates do not possess the property of flocculation to any appreciable degree, but rather tend to form dense, compact, crystalline particles that settle rapidly. Precipitates of ferric hydroxide, aluminum hydroxide, silica, and certain other substances formed by reaction of coagulation chemicals, however, have the property of forming large flocs of high surface area. As these flocs move through the liquid in a settling tank, they remove other suspended solids by adsorption or mechanical sweeping, and hence perform a better clarification than could be achieved by plain sedimentation alone. Removal of color, especially the brownish color due to colloidal vegetable material, is often appreciable; this removal is attributed to the adsorptive action of the floc.

Properly digested sludge from sewage or most industrial wastes is a brown or black humus with no offensive odor. The water-binding property of digested sludge is much less than that of raw sludge, hence digested sludge is readily filtered or dewatered on drying beds. Dried sludge is a good soil conditioner, and contains an appreciable, although not a large, concentration of plant nutrient minerals.

Disposal of industrial wastes and sludges at sea has been practiced in coastal areas; for plants and cities suitably located, it provides a satisfactory means of avoiding stream pollution. Redfeld and Walford (9) have made a detailed study of effects of acid wastes discharged by barge into waters off New York City and the New Jersey coast. Approximately 4000 tons of acid waste was discharged per day, the waste containing 10 percent (100,000 ppm) ferrous sulfate, and 8.5 percent (85,000 ppm) sulfuric acid. This waste was discharged about 14 miles off shore, in an 80-foot depth of water. The acid was found to be dispersed promptly, because of the great dilution available and the resulting neutralization by natural alkalinity in the sea water. There was temporarily an increase in turbidity of the water due to ferric hydroxide formation in the wake of the barge. No effect

Abstract (continued)

on aquatic life was detected other than a temporary immobilization of zooplankton, which recovered promptly as the waste became diluted. It was concluded that there were no undesirable effects from this method of disposal in the area selected.

Treatment of stream waters themselves after discharge of an industrial waste is sometimes resorted to as a final step in the treatment process. Aeration of an entire river has been practiced in order to maintain a positive dissolved oxygen content and to reduce the effects of organic pollution (3). Sodium nitrate additions are regularly used in one Maine stream to prevent development of anaerobic conditions. Industrial wastes high in organic constituents are sometimes chlorinated to prevent or retard development of septicity during their passage through a small stream, until adequate dilution and dissolved oxygen are provided by increased stream flow or entry into tidal waters.

Grinding and comminuting operations are far less common in industrial waste treatment practice than in municipal sewage disposal, as it is usually considered preferable to separate coarse solids at the earliest possible stage rather than to grind them for subsequent removal in sedimentation tanks. Coarse solids from industrial wastes are usually not as obnoxious as coarse sewage solids, hence their handling presents fewer problems. In canneries, for example, such wastes as pea pods, corn husks, and other vegetable solids could be comminuted and so passed along to the settling tanks, but it is better to remove these materials at their points of origin, and to handle them in solid form for dumping, composting, or incineration.

Dumping and Burial

The final disposal of waste solids is by dumping on waste land or on land that requires fill. Some wastes mix readily with earth to produce a suitable soil for plant growth; these may be discharged on flat land areas and worked into the soil by plowing or harrowing. Other wastes, particularly those of inorganic composition, are not desirable in soils, and should be buried on waste land. The usual means for disposal is by dumping into pits of natural or artificial origin, and covering with earth. Consideration should be given to possible leaching of soluble constituents from the dump, since seepage might result in contamination of near-by surface streams or underground aquifers. Either the preceding treatment should be thorough enough to remove soluble pollutants, or the waste should be transported to an area where pollution of natural waters is of little consequence.

Most waste treatment processes lead to formation of sludges that still require disposal. Several methods for reduction of sludge volume have been described earlier, together with methods for final disposal. Selection of the best process for a given plant depends not only on the quantity and character of sludge, but also on local conditions and plant economics; it is a matter requiring sound engineering judgement.

Ponding of beet sugar wastes has been practiced at many mills, but is not usually satisfactory because of anaerobic decomposition of settled solids, and the resulting development of odors and lifting of solids by gas. Lime slurry ponding is practical, although sludge must generally be removed annually; lime sludge is frequently acceptable to local farmers for fertilizing and soil building use. Present-day practice involves re-use of many wastes that were previously

## Abstract (continued)

discarded, after treatment by clarification and chlorination. Disposal of final effluents by irrigation has been outstandingly successful in several installations.

In most canning industries, the principal liquid wastes are formed during food-cleaning and food-washing operations, and from periodic cleanups of equipment and floors, Large quantities of solid wastes are produced; if these are stored as silage, strong liquid wastes form and drain from the silos. Blanching of vegetables is a source of concentrated waste high in dissolved solids. The BOD of cannery wastes, expressed in pounds per case of twenty-four No. 2 cans, varies from 0.05 for wax beans to 1.0 for spinach. The stream pollution problem is caused primarily by high organic content and BOD of these wastes.

Screening is almost universally employed as primary treatment for cannery wastes. Vibrating screens of 10 or 20 mesh are most popular, althoygh finer screens have been used in some plants, and rotary screens are also common. Disposal of screenings may be a problem in some areas.

Chemical coagulation and sedimentation have been recommended for treatment of cannery wastes, and these operations are in use at several plants packing peas and other vegetables. Most of these installations employ the fill-and-draw principle rather than continuous operation, because better settling and sludge concentration are accomplished. About 30 minutes is required for chemical addition, and flocculation, 2 hours or more for settling, and 1 to 1-1/2 hours for discharge of effluent and sludge removal. Lime in quantities of 5 to 10 pounds per 1000 gallons is employed as coagulant, frequently aided by iron salts, alum, or zinc chloride. Sludge from chemical precipitation dries satisfactorily on sand beds in 5 to 7 days, and its disposal is not a difficult problem.

If soil characteristics are satisfactory, waste may be spread on cultivated land instead of lagooned, being plowed into the soil after it has dried sufficiently.

Treated wastes, and even raw wastes from small dairies, have been disposed of by dilution in streams or by irrigation on land. Disposal of sludge from trickling filters or activated sludge plants may be a difficult problem. In some plants this sludge has been dried on sand beds or digested; in others it is hauled away for dumping or burial.

The principal potential pollutional load from a distillery is stillage, the residual grain mash from distillation columns. This material, however, is recovered almost completely by the industry for animal feed or for conversion to chemical products. Without such recovery, the population equivalent of distillery wastes, based on BOD, is about 40,000 per 1000 bushels of grain mashed. With dried grains recovery only, as by screening, the population equivalent is reduced to 30,000; and with complete stillage recover, pollutional load is reduced to 2000 or 3000 population equivalent. It has been reported that 85 per cent of the stillage from beverage distilleries in 1952 was recovered as dried feeds, 14 percent as wet feed, and only 1 percent was lost. Residual wastes from a modern distillery employing complete feed recovery are large in volume, but weak; they may frequently be disposed of by dilution or, if that is not satisfactory, by treatment on trickling filters. Stabilization of more concentrated wastes by anaerobic digestion or fermentation is possible.

## Abstract (continued)

Wastes from stockyards, slaughterhouses, and meat packers are similar to domestic sewage, but may be ten times or more stronger. They contain both suspended and dissolved material, principally of organic nature; and their principal pollutional effect on streams is the result of high BOD. Stockyard wastes include manure, fibrous materials such as hay and straw, and dirt. Slaughterhouses and packing plants produce blood, grease, hair, manure, fleshings, and dirt. The BOD of whole blood is about 165,000 ppm, which indicates the highly pollutional nature of these wastes.

A recent development, in the pilot plant stage during 1953, involves treatment of raw coke oven gas with spent pickle liquor from the steel industry. Sulfate ions in the spent pickle are a substitute for the sulfuric acid ordinarily purchased to recover ammonia from coke oven gas; the product is a pure ammonium sulfate. It has been demonstrated in the laboratory that hydrogen sulfide in the gas can be removed by this process and recovered as elemental sulfur. There is experimental evidence that much of the pyridine in the gas can be salvaged in marketable form, and that cyanides are recoverable as sodium or calcium ferrocyanide. The final sludge consists primarily of oxides of iron; it can be sintered and recharged to the blast furnace. There is no liquid effluent from the treatment process, which therefore apparently solves a portion of the pollution problems of two major industries.

By-product recovery from spent pickle liquor is possible in many different ways, but few of them have been developed successfully on a plant scale. Among the by-products that can be recovered are copperas and other ferrous sulfates, ferric sulfate, sulfuric acid, iron oxide, metallic iron, and various sludges that can be converted into building materials.

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(2) Simpson, R. W., "The Effect of Synthetic Detergents on Sewage Treatment, Am. City, 67, No. 10, 92-4 (1952).

(11) Hess, R. W. (leader), et al., Discussions in "1952 Industrial Wastes Forum," Sewage and Ind. Wastes, 25, 706-15 (1953)

(8) Arbogast, C. H. P., "Incineration of Wastes from Large Pharmaceutical Establishments," Purdue Univ. Eng. Bull, Extension Ser. No. 68, 255-9, 1949.

(9) Redfeld, A. C., and L. A. Walford, "A Study of the Disposal of Chemical Waste at Sea." Natl. Research Council Publ. No. 201, 1951

(3) "Aerating a River to Reduce Pollution," Eng. News-Record, 136, 416-18 (1946).

Descriptors (continued)

potable
brines
leach
aerobic
sedimentation
screening
burial
incineration
anaerobic
oxidation
trickling filters
decomposition
digestion
fermentation
chlorination
flocculation
zooplankton
lime sludge
lagooned
fibrous materials
fleshings
pyridine

"distillers' slops"
"still bottoms"
sedimentation
vertical flow sedimentation
centrifugal sedimentation
colloidal system
chemical coagulation
gravity separators
filtration
drying
fertilizer
Hormel process
Overhold process
garbage
coagulation
humus
comminuting
silage
stillage
straw
raw coke
sintered
building materials

clarifier
septic
centrifuges
extraction
emulsions
distillation
adsorption
tars
flotation
vaporization
rotary driers
cannery wastes
rubbish
manures
contaminants
soil conditioner
ponding
cannery wastes
hay
dirt
pickle liquor

Disease/Solid Waste
Abstracts

No. DSW- 201

Author

Samuel A. Hart and Paul E. Schleusener

Title Rural Wastes and Agricultural Engineering

Reference
Agricultural Engineering

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| vol. 44, no. 3, p. 142 | | March 1963 |

Abstract

Livestock manures and waste water from animal production operations. The total volume of America's livestock manure is estimated 1.8 billion cu yd per year.

Crop residues. The corn stalks and tree prunings left in the field, the pea vines hauled back onto the farm after being shelled out at the processing plant, green drop resulting from fruit-marketing orders, cull fruit and produce that do not go to market, and similar products are the crop residues which create agricultural sanitation problems.

Wastes from rural processing plants and industrial factories.

Agricultural chemicals. Fertilizers, insecticides, herbicides, and the like, which are used to increase food production, of ten may persist and cause problems.

Livestock manures from some of the feedlots, dairies, and poultry farms adjacent to municipalities are not commercially disposable as they are produced. They are too wet, too rich in nitrogen and other fertilizer components, and too dense to compost. On the other hand, the refuse and garbage from adjacent municipalities is too dry, too low in nutrients, and too bulky to compost. Mixing the two wastes gives an excellent compost which is sueful as a soil conditioner and amendment.

Descriptors
manures
crop residues
green drop
wastes
fertilizers
insecticides
herbicides
nitrogen
compost
refuse
garbage
soil conditioner

Disease/Solid Waste
Abstracts

No. DSW-202

Author

W. A. Hardenbergh

Title

Sewerage and Sewage Treatment (1950)

Reference

Haddon Craftsmen, Inc. Pennsylvania

Doc. No. Contract No. Date issued

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Abstract

Data on Industrial Wastes-Basic data on some common industrial wastes are given in the following articles. Where available, the following information is given: (1) the standard unit of production for the industry; (2) the usual volume of waste per unit or production; (3) the BOD of the waste produced; (4) a brief statement regarding the methods of treatment that have been found applicable. Much of the data here given are from the report by the U.S. Public Health Service as a result of its study of industrial wastes in the Ohio River Basin; and the remainder is from the October, 1949, issue of Public Works Magazine.

Laundry Wastes-In laundries the unit of production is 100 pounds of dry wash received. The waste per unit of production in a well-run laundry will average 350 to 500 gallons. The BOD of the waste will range from 1,000 to 1.500 ppm; the suspended solids, from 400 to 600 ppm; and grease, 400 to 500 ppm. The waste is highly alkaline. Chemical precipitation, trickling filters, and activated sludge have been used as treatment methods.

Milk and Creamery Wastes-The unit of production in a milk-handling plant is 1000 pounds of milk received daily. The volume and strength of wastes produced in well-operated plants, per 1000 pounds of milk intake per day, are as follows: receiving station, 175 gallons with BOD of 500 ppm; bottling plant, 250 gall with BOD of 1,500 ppm; cheese factory, 200 gall. with BOD of 1,000 ppm; milk-condensing plant, 150 gall. with BOD of 1,300 ppm; and creamery, 110 gall. with BOD of 1.250 ppm.

Low-rate and hig-rate trickling filters and activated sludge give good results in treating milk and creamery wastes. When high-rate filters are used, filter loadings may range from 1.3 to 2.0 pounds of BOD per cubic yard per day. A tile medium is sometimes used. Two-stage filters are usually necessary to obtain effluents having BOD concentrations under 50 ppm. Anaerobic decomposition in septic tanks for about 48 hours, followed by sand filtration of rates of 50,000 gall. per acre per day, has been reported as satisfactory.

Wastes of Meat-Packing Plants-The unit of production in a meat-packing plant is one hog processed daily. Each head of cattle is equal to 2-1/2 hog units; each

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Descriptors

BOD
precipitation
trickling filters
sedimentation
lagooning
sludge
industrial wastes
suspended solids
anaerobic
pathogenic organisms
filtration
ponding
alkaline
activated sludge
septic tanks
sewage
disposal

Abstract(continued)

hog, calf, or lamb is equivalent to one hog unit. Average volumes and strengths of the wastes per hog unit are: packing plant, 500 gall. with BOD of 900 ppm; and slaughterhouse, 150 gall. with BOD of 2,200 ppm. A stockyard will produce about 25,000 gall. of waste per day per acre of area, and the average BOD will be 65 ppm.

The unit of production for processing poultry is 1,000 pounds of live weight of poultry; and for each such unit there will be produced about 2,200 gall. of waste having a BOD of 2,700 ppm.

Sedimentation removes about 35 per cent of the BOD in meat-packing wastes. Chemical precipitation may give added removal, up to 80 per cent, when ferric chloride or aluminum sulfate is used; but the BOD of the effluent will still be very high. Activated sludge and low-rate and high-rate filters are effective. Although the wastes from meat-packing plants resemble domestic sewage in many respects, danger from pathogenic organisms is small.

Cannery Wastes-The unit of production for canneries is normally the number of cases of No. 2 cans produced daily, there being 24 cans in each case. The volume of flow per case and the strength of the waste vary materially, the values depending on the product. Data on some common cannery wastes are given in Table 34.

Although both trickling filters and activated sludge have been used successfully to treat cannery wastes, the short canning season normal in many areas practically precludes their use. As previously stated, lagooning has been used effectively, it being necessary to provide sufficient lagoon capacity to retain the entire flow from the season's run. Fine screens with 10 to 40 meshes per inch should precede any treatment method.

Tannery Wastes-This unit of production in tanneries is 100 pounds of raw hides processed daily, which will produce about 68 pounds of finished leather. Waste volume per unit will be about 800 gallons with a BOD of about 1,200 ppm where vegetable tanning methods are used and a BOD of 600 ppm where the chrome method is employed. Wastes are usually highly alkaline and strongly colored. Regulation of discharge through storage and mixing is desirable.

Treatment of tannery wastes is difficult. Intermittent sand of cinder filters have been effective in removing BOD and color. Settling for up to 24 hours removes 40 to 50 per cent of the BOD and as much as 70 per cent of the suspended solids; and such sedimentation should precede filtration. Disposal of the sludge, which amounts to 7 to 10 per cant of the volume of the waste, is difficult, as drying on beds is slow. Chemical precipitation has not been efficient. Low-rate trickling filters reduce the BOD concentration materially but do not remove much of the color.

Wool-Scouring Wastes-The unit of daily production in wool scouring is 100 pounds of wool processed. Average waste production is reported as 100 to 150 galls. per unit with a pH value of 9 to 9.5 and a BOD concentration of 9,000 ppm. Alkalinity is very high, having been reported in excess of 7,000 ppm. Treatment with chemicals may reduce the BOD up to 50 per cent, but results in a voluminous sludge which it is difficult to handle.

Paper-Manufacturing Wastes-The unit of production for both pulp-manufacturing and paper-manufacturing plants is the ton of product produced daily. Volumes and strengths of wastes are as shown in Table 35.

Plants de-inking waste paper produce about 83,000 gallons of waste per unit with a BOD of 300 ppm.

Good plant management, maximum use of screens and savealls to reduce fiber loss, and recirculation to reduce the strength of the waste are essential. Chemical treatment may remove 60 to 65 per cent of the BOD of the waste. Lagooning or ponding for 60 days has been reported as giving good results; filtration has also been satisfactory. Odors may be a problem in lagoons. Sufficient data are not now available for designing large-scale filters for paper wastes.

## Abstract (continued)

**Distillery Wastes**-The unit of production for grain liquors is either 1,000 bushels of grain mashed per day or the equivalent 5,000 gallons of 100-proof spirits produced. For molasses distilling, the unit of daily production is 1,000 gallons of 100-proof liquor. The combined wastes from a grain distillery will amount to about 600,000 gallons per unit of production. The molasses distillery will produce about one-fifth as much waste per unit, and it will be noted that the production unit for a molasses distillery is one-fifth of that for the grain distillery.

The thin slop from grain distilling, which has a BOD content of about 34,000 ppm amounts to 25,000 to 35,000 gallons per production unit. The pH value may be as low as 3.7; the chlorine demand may be 500 ppm; and total solids may amount to 50,000 ppm, of which 90 per cent are volatile solids. Thin slop from a molasses distillery, which amounts to 8,000 to 10,000 gallons per production unit, has the same characteristics as the grain-distillery slop.

Treatment of distillery wastes is difficult. Lagooning creates odors and may cause fly-breeding. Irrigation requires frequent cultivation; and 1 acre of favorable land will not dispose of more than 10,000 gallons of slop per day. Data are lacking on the effectiveness of large-scale biological treatment plants.

**Brewery Wastes**-The unit of production for a brewery is the barrel of 31 gallons. Waste flow per unit averages 300 gallons. Strength of the waste depends on the method of handling the spent grain. If the grain is sold, as is usual with small plants, the BOD content of the waste will be about 800 ppm. If the yeast and water are extracted from the grain, the BOD of the wastes will be about 1,200 ppm.

Treatment of brewery wastes on trickling filters has been effective; for high BOD reductions, two-stage filtration is necessary. Filters must be preceded by sedimentation units providing detention for 1-1/2 to 2 hours.

**Soft-Drink Bottling**-The unit of daily production in a bottling plant is 100 cases of the bottled product. Waste volume per unit is about 1,500 gallons with a BOD content of 150 ppm, total solids amounting to 700 ppm, and settleable solids amounting to 20 ppm. The sugar content of the wastes depletes stream oxygen. Both high-rate and low-rate filters have been used in the treatment of wastes from plants for bottling soft drinks.

**Cotton Textile Wastes**-The unit of daily production for cotton textiles is 1,000 pounds of goods processed. For various processes, volumes and strengths of waste are given in Table 36.

It may be assumed that 1,000 gallons of composite wastes from cotton mills are equivalent to the sewage from 20 persons. Chemical coagulation has been reported to reduce the BOD of textile wastes by as much as 70 per cent. Ponding has been used with good results. Activated sludge and trickling filters are effective methods of treatment, but the latter do not give a very high removal of color.

**Oil Wastes**-Waste flow from oil refineries averages 700 to 800 gallons per barrel of oil processed, and the BOD content of the wastes ranges from 10 to 30 ppm. If the water is not reused, cooling water accounts for 80 to 90 per cent of the waste volume. Until fuller data are available, it may be assumed that the wastes from 1,000 barrels of oil processed are equivalent to sewage from 60 persons. These wastes contain free and emulsified oil that forms films on water, coats objects with which it comes in contact, causes tastes and odors in the water, and may form sludge deposits. Good plant operation to prevent discharge of oil due to spillage or dumping is essential. Sedimentation and aeration have been employed to remove the oil from the waste water.

Brines are common problems in oil-fields. Discharge into underground

Abstract (continued)

formations is often employed for disposal of brine. Excess carbonates and iron must be removed from the wastes to prevent clogging of the subsurface strata.

Coke Wastes-The unit of production in a coke plant is 1 ton of coal carbonized. On the average, waste amounts to 3,600 gallons per unit of production with a BOD content of 85 ppm and a phenol content of 20 ppm. The phenol content may cause highly disagreeable tastes in chlorinated waters. Pollution reduction is accomplished largely by good housekeeping in the production plant and by maximum reuse of water. Phenol removal can be accomplished by sand filters, trickling filters, or activated sludge; but, since a large plant is required, such treatment is not generally economical.

Abstract (continued)

## TABLE 34

## VOLUME AND STRENGTH OF CANNERY WASTES

| Product | Gallons per Day per Case | BOD of Waste p.p.m | Suspended Solids of Waste ppm |
|---|---|---|---|
| Asparagus | 70 | 100 | 30 |
| Corn, Cream | 25 | 620 | 300 |
| Corn, Whole | 25 | 2,000 | 1,250 |
| Tomatoes, Whole | 7-1/2 | 4,000 | 250 |
| Tomato products | 70 | 1,000 | 2,000 |
| Green beans | 35 | 200 | 60 |
| Lima beans | 250 | 190 | 420 |
| Peas | 25 | 1,700 | 400 |
| Sauerkraut | 3 | 6,300 | 630 |
| Spinach | 160 | 615 | - |
| Beets | 37 | 2,600 | 1,530 |
| Pork and beans | 35 | 925 | 225 |

Abstract (continued)

TABLE 35

WASTES FROM PAPER AND PULP MILLS

| Pulp-Mill Product | Gallons per Day per Unit | BOD ppm | Paper-Mill Product | Gallons per Day per Unit | BOD ppm |
|---|---|---|---|---|---|
| Ground wood | 5,000 | 645 | Miscellaneous, no bleach | 39,000 | 19 |
| Soda pulping | 85,000 | 110 | | | |
| Sulfate or Kraft | 64,000 | 125 | Miscellaneous, bleach | 47,000 | 24 |
| Sulfite | 60,000 | 450 | Paperboard | 14,000 | 121 |
| | | | Strawboard | 26,000 | 695 |

Abstract (continued)

TABLE 36

VOLUMES AND STRENGTHS OF COTTON TEXTILE WASTES

| Process | Gallons per 1,000 pounds | BOD ppm | Dyeing | Gallons per 1,000 pounds | BOD ppm |
|---|---|---|---|---|---|
| Sizing | 60 | 820 | Direct | 6,400 | 220 |
| Desizing | 1,100 | 1,750 | Basic | 18,000 | 100 |
| Kiering | 1,700 | 1,240 | Vat | 19,000 | 140 |
| Bleaching | 1,200 | 300 | Sulfur | 5,400 | 1,300 |
| Souring | 3,400 | 72 | Developed | 14,400 | 110 |
| Mercerizing | 30,000 | 55 | Naphthol | 4,800 | 250 |
| | | | Aniline Black | 15,600 | 55 |

Disease/Solid Waste
Abstracts

No. DSW- 203

Author Committee on Potato Chip Wastes of the Potato Chip Institute International in cooperation with the National Technical Task Committee on

Title Industrial Wastes

Potato Chip Industry

Reference
U.S. Dept. of H.E. & W., Pub. Health Service,
Div. of Water Supply and Pollution Control.

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| PHS Pub. No. 756 | | 1960 |

Abstract

Suspended solids will average about 30 pounds for each 1,000 pounds potatoes processed. Based on a suspended solids population equivalent of 0.20 pounts, this amounts to the suspended matter dischanged by 165 people.

The discharge of untreated potato chip wastes has several undesirable effects upon the receiving watercourse. Floating solids create a visual nuisance while decomposable organic sludges drain available dissolved oxygen from the flowing waters. The high turbidity interferes with light penetration thereby reducing normal algal life. The organic matter in the wastes may undergo rapid decomposition utilizing oxygen that may be reduced to low levels in the stream. The solids coat the stream bottom breaking the normal food chains for stream biota. Fish habitat may be destroyed, or at least damaged. The sum total effect may be the creation of a stream not available for maximum beneficial use.

SOLUBLE SOLIDS REMOVAL One of the methods for the removal of soluble solids; i. e., sugars, amino acids, and minerals, is their conversion into algal masses in stabilization ponds.

A mthod for removing amino acids and the purification of the same has been patented by Xander at al. (14.)

GREASE A grease trap is useful in separating grease (from other wastes) which arises during machinery cleaning operations.

FEED VALUE OF RECOVERED SOLIDS Solids recovered have a feeding value for dairy cows approximately one-third that of alfalfa. (2). Dairy cows utilize the raw as well as cooked product but the wastes must be cooked when fed to hogs to achieve maximum nutritional value.

The wastes can also be dehydrated and fed as supplements to other foods. A typical analysis of the dried product is as follows: Moisture 10 percent, carbohydrates 68 percent, protein 9.5 percent, minerals 4.0 percent, fiber 7 percent, and fat 1.5 percent.

Potato wastes unless mixed with sanitary sewage are seldom, if ever, contaminated with pathogenic organisms which affect public health. Furthermore, they

Descriptors
sludges
decomposition
stream biota
soluble solids
stabilization ponds
grease
feeding value
dehydrated
pathogenic organisms
public health
irrigation
organic
comminute

solids
settling basins
lagoons
stabilization ponds
purification
trickling filters
coagulation
sewage
shaker screens
centrifuges
settling tanks
wastes
suspended solids
population equivalent

afford valuable organic materials as well as some minerals which if applied to farm lands may ultimately lead to increased yields. The use of the liquid wastes for irrigation may also offer certain economies when the plant is located in a farm area. The combined liquid and solid wastes can be spread by flood, furrow or ditch techniques to land. No attempt has been made to comminute the solids so that they can also be sprayed onto the land as in the case in the canning industry. 4. Brown, R. D. 1956. Hale, Harold H. and Sheets, W. D. 1955. Reprint from Aug. and Sept. Food Packer. Settling basins may be employed for holding the effluent from the chip plant. A holding period of one hour is sufficient for the removal of most of the starch and large solids (approximately 50 percent of the total B.O.D.). LAGOONS In some areas lagoons may be used, providing the location of the lagoon does not result in an odor nuisance. STABILIZATION PONDS One rather new development is the use of stabilization ponds. Ponds have been used throughout the world for may years to: (1) remove suspended matter; (2) regulate erratic waste flow patterns; (3) store wastes for release during high stream flows and to a lesser extent, store for later irrigation use; and (4) propagate fish with fertilized water. More recently (since 1948) it has been recognized that stabilization ponds may provide a degree of purification comparable to that achieved by conventional complete treatment processed.

TRICKLING FILTERS AND CHEMICAL COAGULATION Trickling filters have been employed for treating canning wastes. Year-around operation of potato chip plants should permit more effective operation of trickling filters. Chemical coagulation (rather expensive) has been used for partial treatment where untreated wastes may overload small municipal treatment plants.

MUNICIPAL PLANTS The most used and probably the best method of waste disposal is that of discharging the sewage into a municipal system. Approximately 50 percent of the B.O.D. is produced by solids that can be removed (peels, trimmings and starch) by shaker screens or basket centrifuges. Another 25 percent of B.O.D. can be removed by settling tanks.

## Source and Volume of Wastes

The primary sources of wastes are shown in figure 2. Wastes are derived from the peeling, trimming, slicing, and rinse operations. Other wastes accrue from clean-up, small amounts of waste oil, and occasionally sanitary sewage.

Table II presents plant data on waste flows based upon a unit production of 1,000 pounds of potatoes.

Table II.-- Plant operation and wastes discharged per 1,000 lbs. of potatoes processed (11).

| Plant | Month | Employees (number) | Potato chips* (pounds) | Waste flow (gallons) | B.O.D. | | Suspended solids | |
|---|---|---|---|---|---|---|---|---|
| | | | | | p.p.m. | lbs. | p.p.m. | lbs. |
| A | July | 0.9 | 240 | 2,480 | 730 | 15.0 | 820 | 24.3 |
| B | December | 1.3 | 260 | 2,020 | 1,560 | 26.2 | 2,140 | 35.9 |
| C | October | 1.0 | 240 | 2,000 | 1,850 | 30.8 | 2,190 | 36.4 |
| D | December | 2.3 | 255 | 1,450 | 1,200 | **14.5 | 1,700 | **20.4 |
| Average | | 1.4 | 250 | 1,990 | | | | |

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*Average weight of oil on finished chip is 40%.

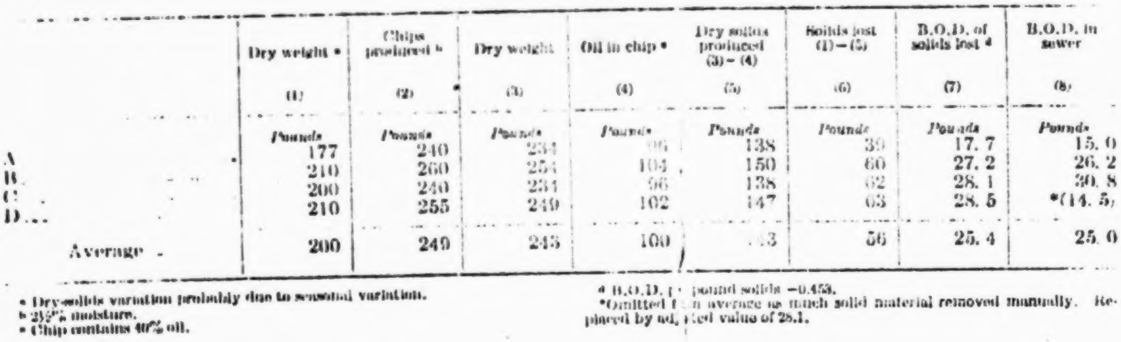
**Much solid material was removed manually and did not reach the sewer.

## References

4. Brown, H. D., Hale, Harold H. and Sheets, W. D. 1955. Reprint from Aug. and Sept. Food Packer.

11. Porges, R. and Towne, W. W., "Wastes from the Potato Chip Industry." Sewage and Industrial Wastes, 31, 1, 53-59 (January 1959).

Table III.-- Solids balance and B.O.D. relationship per 1,000 pounds potatoes (11).



| | Dry weight [a] (1) | Chips produced [b] (2) | Dry weight (3) | Oil in chip [c] (4) | Dry solids produced (3)−(4) (5) | Solids lost (1)−(5) (6) | B.O.D. of solids lost [d] (7) | B.O.D. in sewer (8) |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* |
| A | 177 | 240 | 234 | 96 | 138 | 39 | 17.7 | 15.0 |
| B | 210 | 260 | 254 | 104 | 150 | 60 | 27.2 | 26.2 |
| C | 200 | 240 | 234 | 96 | 138 | 62 | 28.1 | 30.8 |
| D | 210 | 255 | 249 | 102 | 147 | 63 | 28.5 | [e](14.5) |
| Average | 200 | 249 | 243 | 100 | 143 | 56 | 25.4 | 25.0 |

[a] Dry-solids variation probably due to seasonal variation.
[b] 2½% moisture.
[c] Chip contains 40% oil.
[d] B.O.D. per pound solids =0.453.
[e] Omitted from average as much solid material removed manually. Replaced by adjusted value of 28.1.

Disease/Solid Waste
Abstracts

No. DSW- 204

Author National Stream Sanitation Committee of the American Association of Textile Chemists and Colorists in cooperation with the National Task

Title Committee on Industrial Wastes
Cotton Textile Industry

Reference U.S.Dept. of H.E. & W., Public Health Service, Bureau of State Services

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| PHS Pub. No. 677 | | 1959 |

Abstract

The desizing operation provides perhaps the largest single contribution of B.O.D. to the cotton textile waste, as much as 50 percent coming from this source alone. The process is essentially a hydrolysis of the starch size by acid or enzymatic means. This removes not only the cotton wax and other noncellulose materials from the raw cotton, but also dirt, grease, and other foreign matter. Wastes from this operation are usually very strong and contain considerable alkali. Kier Wastes: These wastes are fairly high in organic matter and are strongly alkaline. They contain natural vegetable fat, waxes and pectin, solid fragments from the cotton ball, starch or other sizing material which was not removed in the desizer, and caustic soda, soda ash, silicate, and small amounts of other chemicals used in the kier bath. Bleaching Wastes: The wastes from the chlorine and hypochlorite processes are similar in characteristics, being strongly alkaline, and containing partially spent bleaching agents and the organic matter removed from the cotton. Dyeing Wastes: The largest volume of waste from the textile-finishing plant comes from the dyeing operations. The dye wastes are all large in volume, high in color, and some may be toxic. The chemicals used in this process run the gamut of the chemists' handbook. Miscellaneous Wastes: Miscellaneous wastes from the color-printing and finishing machines are usually low in volume and occur principally from the cleanup operations on the machines and kettle washings. Materials such as starch, dye, gums, waxes, and resins are the principal polluting materials in these wastes. Composite Wastes: A composite of the wastes from an integrated cotton textile processing plant consists mainly of the following materials: starch, dextrin, gums, glucose, waxes, pectins, alcohols, acetic acid, soap, detergents, sodium hydroxide, carbonate, sulfate, and chloride. It has a total solids content from 1,000 to 1,600 p.p.m., a B.O.D. of 200-600p.p.m. total alkalinity of 300-900 p.p.m., suspended solids of 30-50 p.p.m. and chromium up to 3 p.p.m. Process waters can frequently be used as makeup for subsequent operations. Studies of processes can be made with the aim of reducing the overall quantity of process chemicals which are ultimately wasted. Recovery and reuse of chemicals and byproducts,

Descriptors
B.O.D.
waste
acid
dirt
grease
alkali
Organic matter
alkaline
vegetable fat
waxes
pectin
starch
digested
caustic soda
soda ash
silicate
chlorine
hypochlorite processes
bleaching agents
toxic
chemicals
starch
dextrin
gums
glucose
waxes
pectins
alcohols
acetic acid
soap
detergents
sodium hydroxide
carbonate
sulfate
chloride
suspended solids
chromium
caustic
sodium hydroxide
evaporation
pollution
CMC
acetic acid
starch
textile wastes
lagoons
sedimentation
screening
mechanical filtration
sludge
cum
eration
neutralization
umus
reducing agents
micro-organisms
pollution
septic
trickling filter
activated sludge
contact aeration
endogenous respiration
oxidation pond
dewatered
dried
buried
land fill
disposal
fertilizer

340<

if it can result in savings, is a third possibility. In many bleacheries, over 70 percent of the caustic which goes to waste could be recovered economically. If there is available annually as much as 400 tons of sodium hydroxide at a minimum strength of 2 percent, its recovery by evaporation for reuse may be economically feasible. Process Modification: A fourth way to achiefe waste reduction is by process modification. One great area for exploration in the reduction of waste loads is the substitution of chemicals with low pollution effects for those with high pollution effects. The substitution of CMC for starch in the slasher (sizing) operation. Up to half of the total pollution load can be eliminated by this inplant substitution. Replacement of acetic acid by a mineral acid in the various dyeing processes reduced the total pollution load of one plant by 22 percent, and of another plant, 10-15 percent (10). Replacement of soap by synthetic detergents has cut the pollution load at some plants by 50 percent. The last step in pollution reduction from plant operation is the practice of good housekeeping.

The extreme variation in flows and characteristics of textile wastes makes equalization of flow a basic requirement for the first step of any treatment method. Large storage ponds, sometimes classified as "lagoonds," are constructed to take advantage of some waste purification; they allow time for sedimentation of the larger solid waste particles.

Screening is a necessary adjunct to the treatment of most wastes because large particulate matter, if not removed, would cause clogging of sewers and interference in the subsequent treatment processes.

Mechanical filtration has been used to treat the various types of textile wastes either after chemical precipitation or after the addition of absorbent materials to remove color. The resulting sludge or scum could be disposed of by burning. In practically all cases, aeration is useful in conjunction with other treatment methods, either as a pretreatment or as a final effluent polish. Neutralization, or pH adjustment, is necessary when the waste to be treated is either too acid or too alkaline for proper biological treatment. The biological treatment processes available can operate successfully at high alkalinities, depending on the process and on the type of waste, and reducing the chemical costs of neutralization.

The treatment usually recommended in the past for cotton textile wastes has been chemical precipitation. Plant facilities required for chemical precipitation of wastes include the following: equalization basin, rapid mix basin, settling tanks or lagoons, chemical feeders and feed control devices, mixers, pH meters and recording instruments, sludge-handling equipment, and chemical storage facilities.

Wastes which contain reducing agents or compounds which are easily oxidized by oxygen should not be permitted to enter the receiving stream without treatment. The organic matter present in the cotton textile wastes, if discharged into the receiving stream, provides a food source for the many micro-organisms present in the water. Excessive pollution by organic and other oxygen-consuming compounds produces septic conditions resulting in odors, floating scum, sludge banks, and other indications of gross pollution. The removal of this organic load from waste effluents is carried out by one of several biological methods.

The Trickling Filter Process: The Activated Sludge Process: Contact aeration. Endogenous respiration is a process whereby the waste, after seeding with biologically active sludge, is aerated until the organic matter of the waste is totally oxidized to carbon dioxide, thus eliminating the need for sludge disposal. The process works automatically in that the waste is pumped from a storage pond and flows through slowly. The aeration period may be as long as several days.

The oxidation pond, perhaps the cheapest method for reduction of organic load, is a shallow pond through which the waste is allowed to flow slowly with up to 30 days' retention time. The active organisms are maintained by oxygen from the air and by oxygen produced through the activity of algae. In oxidation ponds, as distinguished from storage ponds, the waste must be kept aerobic either by controlling the depth or by partial recirculation of the pond effluent. These ponds work best in warm, sunny climates. The advantages of the oxidation pond are low construction cost, low maintenance cost, and simplicity of operation. Aeration lagoons provide economy in smaller space requirements.

Sludge Disposal. In most of the physical, chemical, and biological treatment methods described, the process of waste water purification produces a considerable quantity of sludge, or solid matter, which must be removed from the process and disposed of. Sludge from chemical precipitation can be dewatered, dried, and buried or used as a land fill. Sludge from the biological processes and from primary settling tanks is highly organic and requires some further treatment to render it suitable for disposal. It is usually digested under anaerobic conditions, producing a low-grade fuel gas. The digested sludge can be used as a humus. Other methods of disposal are aeration, drying, and incineration, or production of a low-grade fertilizer.

10. Burford, M. G., Masselli, J. W., Snow, W., Campbell, H., and Deluise F., "Industrial Waste Surveys of Two New England Cotton Finishing Plants," New England Interstate Water Pollution Control Commission (1951).

Table II.--Polution effect of cotton processing wastes (composite of all wastes connected with each process).

| Process | Wastes (p.p.m.) | | | Gallons wastes per 1,000 lbs. goods | Pounds B.O.D. per 1,000 lbs. goods | Pounds total solids per 1,000 lbs. goods | Population equivalent per 1,000 lbs. goods |
|---|---|---|---|---|---|---|---|
| | pH | B.O.D. | Total solids | | | | |
| Slashing, sizing yarn* | 7. 0-9. 5 | 620-2, 500 | 8, 500-22, 600 | 60-910 | 0. 5-5. 0 | 47-67 | 2-30 |
| Desizing | ------- | 1,700-5, 200 | 16, 000-32, 000 | 00-1, 100 | 14. 8-16. 1 | 66-70 | 90-100 |
| Kiering | 10-13 | 680-2900 | 7, 600-17, 400 | 10-1, 700 | 1. 5-17. 5 | 19-47 | 10-105 |
| Scouring | ------- | 50-110 | ------- | 2, 00-5, 100 | 1. 36-3. 02 | ------- | 8-18 |
| Bleaching (range) | 8. 5-9. 6 | 90-1, 700 | 2, 300-14, 400 | 00-14, 900 | 5. 0-14. 8 | 38-290 | 30-90 |
| Mercerizing | 5. 5-9. 5 | 45-65 | 600-4, 900 | 27, 00-36, 950 | 10. 5-13. 5 | 185-450 | 60-80 |
| Dyeing: | | | | | | | |
| Aniline black | ------- | 40-55 | 600-1, 200 | 15, 00-23, 000 | 5-10 | 100-200 | 40-60 |
| Basic | 6-7. 5 | 100-200 | 500-800 | 18, 00-26, 000 | 15-50 | 150-250 | 100-400 |
| Developed colors | 5-10 | 75-200 | 2, 900-8, 200 | 8, 00-25, 000 | 15-20 | 325-650 | 90-120 |
| Direct | 6. 5-7. 6 | 220-600 | 2, 200-14, 000 | 1, 00-6, 400 | 1. 3-11. 7 | 25-250 | 25-75 |
| Indigo | 5-10 | 90-1, 700 | 1, 100-9, 500 | 00-6, 000 | 1. 8-9. 5 | 21-63 | 10-60 |
| Naphthol | 5-10 | 15-675 | 4, 500-10, 700 | 2, 00-16, 800 | 2-15 | 200-650 | 13-80 |
| Sulfur | 8-10 | 11-1, 800 | 4, 200-14, 100 | 2, 00-25, 600 | 2-250 | 300-1, 200 | 14-1, 500 |
| Vats | 5-10 | 125-1, 500 | 1, 700-7, 400 | 1, 00-20, 000 | 12-50 | 150-250 | 75-175 |

*Cloth weaving mill waste.

Table V.--Chemical treatment of mixed waste.

| Wastes | Chemicals used (number per 1,000 gal.) | Cost (Cents per 1,000 gal.) | Percent removal | | Reference |
|---|---|---|---|---|---|
| | | | B.O.D. | Color | |
| Sulfur and indigo dye | (1) Copperas 5.85<br>Lime 5.85 | 13.4 | 41.5 | 91.0 | (51) |
| | (2) Alum 20.9<br>Acid 6.5 | 57.0 | 43.7 | 97.5 | ---------- |
| Kier, finishing, dyeing, color shop, mercerizing. | (1) Copperas 4.2 | 5.5 | 18.9 | 0 | (51) |
| | (2) $CaCl_2$ 5.0 | 9.3 | 49.5 | 60.0 | ---------- |
| | (3) Copperas 6.2<br>Lime 2.2 | 10.12 | 41.2 | 30.0 | ---------- |
| | (1) Copperas 4.2 | 5.5 | 20.0 | 50.0 | (51) |
| | (2) Copperas 5.8<br>Lime 5.8 | 14.2 | 59.5 | 83.5 | ---------- |
| | (3) $CaCl_2$ 8.4 | 15.5 | 47.5 | 83.0 | ---------- |
| Dyeing and finishing | (1) Copperas 5.85 | 7.75 | 42.4 | 80.0 | (51) |
| | (2) Copperas 4.2<br>Lime 4.2 | 9.55 | 52.5 | 80.0 | ---------- |
| Mixed dye waste: Vats, sulfur, direct developed, etc. | (1) $Cl_2$ 4.5 | 20.2 | 30–40 | 90.0 | (51) |

Disease/Solid Waste
Abstracts

No. DSW-205

Author Prepared through cooperation of the Natio
Canners Association and the National Technical
Task Committee on Industrial Wastes

Title
Fruit Processing Industry

Reference U. S. Dept. of H.E. & W., Public
Health Service, Division of Water Supply and
Polution Control

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| PHS Pub. No. 952 | | 1962 |

Abstract

Raw, untreated canner wastes consist of small particles, sometime discarded whole pieces of fruit, peel, cores, and pits, suspended in water. The skins and cores are collected in waste hoppers and removed by truck to a disposal or utilization operation. Accumulated pits are a part of the solid waste materials for which better means of disposal are needed. The suspended solids may consist of peel, pits cores, and pieces of defective fruit from the trimming tables. Fruit sugars and acids and syrup spillage from the canning operation constitute the dissolved solids in the liquid waste. Fruit acids and sugars in the waste stimulate rapid and abundant microbial growth in the stream. The most common and expected pollution effect is depletion of the oxygen supply in the stream to a level at which fish life is killed. An important fact to be remembered in consideration of fruit-canning waste is that it does not constitute a direct health problem as it does not contain micro-organisms infectious to human beings or animals.

Whatever the method of final disposal may be, the suspended solids should be removed by screening the composite waste flow. Failure to screen the waste may cause: (1) unsightly conditions in streams because of floating solid materials which may form scum blankets or bottom sludge; (2) unnecessary overload on oxidation ponds or digesters, if this type of treatment is used; or, (3) clogging of sewerlines, filters, and distributors if discharge is to a sewage treatment plant. Screening is required by most pollution control measures. Intentional grinding or comminuting of solids, to pass them through a regulation screen, is not allowed.

Generally the waste solids from canning are a liability to the canner. Often, however, thought and ingenuity can lessen the costs of their disposal. Sometimes a canner is able to arrange for the solid refuse to be hauled away for animal feed and its value as feed is usually considered payment for the hauling. Also, disposal may be by spreading over farmland, or removing to drying beds from which it is later piled and burned. In some urban areas canners have to pay on a tonnage basis to have the solids removed. In these instances it is desirable to have the waste as

Descriptors
cannery wastes
disposal
solid waste
suspended solids
dissolved solids
microbial growth
pollution
health
micro-organisms
scum
cludge
oxidation ponds
digesters
screening
comminuting
animal feed
spreading
burned
stockfeed
ensilage

dry as possible. Vibrating-type screens give drier solids than revolving drum screens. Elevation of the solids to a hopper facilitates loading into trucks and allows considerable dewatering during storage in the hopper.

In some cases cannery waste solids have been successfully turned into dehydrated stockfeed. Other attempts have turned fruit wastes into ensilage. Production of alcohol from fruit solids is technically possible. Economic factors have limited attempts to utilize the wastes.

Disease/Solid Waste
Abstracts

No. DSW- 206

Author Committee on Meat Packing Plant Waste
Disposal of the American Meat Institute
in cooperation with the National Technical
Title Task Committee on Industrial Wastes.
Meat Industry

Reference
U. S. Dept. of H., E., and W., Pub. Health Service,
Bureau of State Services

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| PHS Pub. No. 386 | | Reprinted 1958 |

Abstract

The wastes from stockyards, slaughter-houses, and packinghouses are similar chemically to domestic sewage but are considerably more concentrated. The principal deleterious effect of these wastes on streams and other bodies of water is their deoxygenating effect.

Stockyards: Wastes consist of water trough overflow, liquid excreta and pen wash waters containing manure. Uncovered pens are subject to flushing in rainy weather with consequent leachings from manure and carrying over of manure itself to the sewer. The character of these wastes would be expected to vary widely, dependent on the presence or absence of catch basins, practice in manure removal, frequency of washing, et. An analysis of the wastes from a Chicago stockyard is as follows:

| Determination | Concentration (parts per million) |
|---|---|
| Total suspended solids | 173 |
| Volatile suspended solids | 132 |
| Organic nitrogen | 11 |
| Ammonia nitrogen | 8 |
| 5 day biochemical oxygen demand | 64 |

¹ From Supplement D, Industrial Waste Guides, U. S. Public Health Service, 1943.

Paunch manure is usually segregated from the liquid wastes and disposed of separately. At some of the rural plants, it is hauled away by farmers for soil conditioning. A number of the city slaughterhouses dispose of paunch manure with garbage. The separate disposal of paunch manure reduces materially the settleable

Descriptors
wastes
stockyards
slaughterhouses
packinghouses
excreta
manure
leachings
paunch manure
soil conditioning
settleable solids
garbage
solid refuse
fertilizer
stock feed
meat plant wastes
domestic sewage
pathogenic organisms
trickling filters
activated sludge
chemical treatment
sludge
screening
sedimentation
superchlorination
toxicity
B.O.D.
solids
disposal

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**solids in the effluent entering the sewers. Floor washes contain blood, manure, flesh, and fat particles.**

**Survey data, Telfer packing company recirculating filter.**

| | Sept. 22 | | | Sept. 23 | | |
|---|---|---|---|---|---|---|
| | Raw waste | Septic tank effluent | Final effluent | Raw waste | Septic tank effluent | Final effluent |
| Total solids p. p. m. | 5, 042 | 3, 566 | 1, 962 | 5, 058 | 3, 822 | 1, 916 |
| Total volatile p. p. m. | 2, 762 | 1, 672 | 460 | 2, 364 | 1, 536 | 352 |
| Suspended solids p. p. m. | 1, 160 | 1, 364 | [2] 28 | 420 | 1, 344 | [2] 23 |
| Suspended volatile p. p. m. | 1, 032 | 940 | [2] 18 | 332 | 880 | [2] 14 |
| 5-day B. O. D. p. p. m. | 2, 200 | 755 | [2] 18 | 1, 750 | 725 | [2] 57 |

[1] Michigan Engineering Experiment Station Bulletin No. 96.

[2] Corrected for volume difference resulting from the inclusion of 11,200 gallons per day of cooling water in effluent line.

Some of the smaller packing plants do not produce enough hair to justify its recovery, but dispose of it to farmers with other solid refuse, for fertilizer purposes. The production of fertilizers has lost some of its importance in the packinghouse with the advent of dry rendering which enables production of higher grade tankages which are used more for stock feed than for fertilizer.

Meat plant wastes are quite similar to domestic sewage in their composition and in their effects upon receiving bodies of water. The danger from pathogenic organisms in packinghouse or slaughterhouse wastes, however, is slight. In the absence of adequate dilution the principal deleterious effects of meat plant wastes are oxygen deplention, sludge deposits, discoloration, and general nuisance conditions.

Meat plant wastes are amenable to biological treatment in plants of the type in common use for treatment of domestic sewage. The most satisfactory method is to treat them in conjunction with domestic sewage. Trickling filters, particularly of the type developed by Levine and associates, have proved the most successful. Daily and seasonal variations in loading may cause difficulty with the activated sludge process where packing plant waste is treated alone or with limited quantities of domestic sewage. The operating costs of chemical treatment are high and there is the attendant problem of sludge disposal.

Screening by rotary wire mesh screen removes coarse materials such as hair, flesh, paunch manure, and floating solids. Sedimentation, in an Imhoff tank, was found the most satisfactory process for clarification. Chemical precipitation, while removing more suspended solids, produced an excessive volume of sludge which was ill-smelling and hard to dry.

A number of precipitants have been used in various plants treating packinghouse wastes. The use of superchlorination for the precipitation of proteins as practiced at Austin, Minn., has been abandoned because of cost, the toxicity of the sludge, and the necessity of excluding much of the waste from the treatment processes. At Madison, Wis., chemical precipitation using lime as a coagulant proved successful in the removal of substantial quantities of B.O.D. and solids but has been abandoned, due to the cost of the large quantities of chemical required and the excessive amount of solids remaining for disposal. Chicago is the largest center of meat packing in the world, and the wastes from these establishments are being treated successfully by the activated sludge process.

Table 1.-- Approximate range of flows, analyses, and waste loadings for stockyards, slaughterhouses, and packinghouses.[1]

| Operation | Unit | Waste flow gallons per unit | Typical analysis parts per million | | Waste loading in pounds per unit | |
|---|---|---|---|---|---|---|
| | | | Biochemical oxygen demand | Suspended solids | Biochemical oxygen demand | Suspended solids |
| Stockyard | Acre | 23, 070-36, 600 | 64-100 | [1] 175 | [1] 13. 4 | [1] 36 |
| Slaughterhouse | 1,000 pounds live weight | 435-1, 100 | 650-2, 200 | 930-12, 000 | 8. 4-20. 0 | 3. 5-11. 0 |
| Packinghouse | 1,000 pounds live weight | 750-4, 350 | 120-3, 000 | 233-720 | 5. 2-23. 5 | 2. 0-22. 1 |

[1] Only 1 value available.

Table prepared from data from various sources including technical literature and privat correspondence.

Table 2.--Unit packinghouse losses.[1]

(Pounds per 1,000 pounds of live weight)

| Type | B. O. D. | Suspended solids | Nitrogen | Grease |
|---|---|---|---|---|
| Hogs | 18. 0 | 12. 0 | 2. 67 | 0. 93 |
| Do | 15. 0 | 9. 1 | 1. 29 | 2. 30 |
| Mixed | 12. 7 | 4. 6 | 2. 02 | 1. 44 |
| Hogs | 13. 1 | 9. 8 | 1. 25 | 2. 83 |
| Cattle | 20. 8 | 14. 8 | 2. 24 | . 68 |
| Do | 15. 7 | 14. 8 | 2. 01 | 1. 79 |
| Do | 10. 5 | 10. 0 | 1. 02 | 1. 00 |
| Mixed | 19. 7 | 9. 4 | 2. 59 | . 60 |
| Hogs | 9. 8 | 7. 2 | 1. 46 | . 27 |
| Mixed | 18. 7 | 15. 0 | 2. 18 | 2. 00 |
| Cattle | 10. 0 | 11. 0 | 1. 08 | . 55 |
| Mixed | 14. 7 | 13. 2 | 1. 70 | 1. 5 |
| Do | 6. 5 | 6. 2 | . 79 | . 5 |
| Do | 9. 2 | 11. 2 | 2. 10 | 2. 1 |
| Do | 8. 9 | 10. 8 | . 89 | ------ |
| Do | 21. 6 | 21. 7 | 1. 82 | 6. 0 |
| Average | 14. 6 | 12. 0 | 1. 70 | 1. 63 |

[1] Adapted from a presentation by F. W. Mohlman at the Conference on Research of the American Meat Institute, 1949.

## Table 4.-- Analyses of major components of waste from hog packinghouse[1]

| | Concentration (parts per million) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Solids | | Nitrogen | | Cl as NaCl | Oxygen consumed | 5-day biochemical oxygen demand | pH |
| | Total | Suspended | Organic | $NH_3$ | | | | |
| Killing department | 1, 840 | 220 | 13[illegible] | 6 | 435 | 500 | 825 | 6. 6 |
| Blood and tank water | 44, 640 | 3, 690 | 5, 40[illegible] | 205 | 6, 670 | -------- | 32, 000 | 9. 0 |
| Scalding tub | 13, 560 | 8, 360 | 1, 2[illegible] | 40 | 640 | 4, 300 | 4, 600 | 9. 0 |
| Hog dehairing | 1, 540 | 560 | 1[illegible] | 10 | 290 | 620 | 650 | 6. 7 |
| Hair cook water | 4, 680 | 80 | 58[illegible] | 30 | 290 | -------- | 3, 400 | ------ |
| Hair wash water | 7, 680 | 6, 780 | 82[illegible] | 18 | 230 | 1, 680 | 2, 200 | 6. 9 |
| Meat cutting | 2, 840 | 610 | [illegible] | 2. 5 | 1, 620 | 260 | 520 | 7. 4 |
| Gut washer | 22, 600 | 15, 120 | 6[illegible] | 43 | 360 | -------- | 13, 200 | 6. 0 |
| Curing room | 26, 480 | 1, 800 | [illegible] | 12 | 19, 700 | 2, 520 | 2, 040 | 7. 3 |
| Curing room showers | 34, 100 | 1, 720 | 2[illegible] | 25 | 29, 600 | 875 | 460 | 6. 7 |
| Cured meat wash | 9, 560 | 920 | 10[illegible] | 17. 5 | 6, 200 | 950 | 1, 960 | 7. 3 |
| Pickle | 140, 000 | -------- | 2, 7[illegible] | 37 | 77, 800 | -------- | 18, 000 | 5. 6 |
| Sausage and miscellaneous | 11, 380 | 560 | 1[illegible] | 4 | 880 | 460 | 800 | 7. 3 |
| Lard department | 820 | 180 | [illegible] | 25 | 230 | 200 | 180 | 7. 3 |
| Byproducts | 4, 000 | 1, 380 | 1[illegible] | 50 | 1, 330 | 970 | 2, 200 | 6. 7 |
| Laundry | 18, 620 | 4, 120 | [illegible] | 5 | -------- | 780 | 1, 300 | 9. 6 |

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[1] Iowa Engineering Experiment Station Bulletin No. 100.

## Table 5.--Analyses of combined packinghouse wastes[1]

| Number of plants | Concentration (parts per million) | | | | 5-day biochemical oxygen demand |
|---|---|---|---|---|---|
| | Suspendid solids | | Nitrogen | | |
| | Total | Volatile | Organic | $NH_3$ | |
| 28 | 699 | 597 | 116 | 25 | 953 |
| 4 | 398 | -------- | 98 | ----- | 587 |
| 1 | 467 | -------- | 68 | ----- | 550 |
| 1 | 708 | 613 | -------- | ----- | 758 |
| 1 | 720 | -------- | -------- | ----- | 955 |
| 1 | 233 | 105 | -------- | ----- | 372 |
| 1 | 534 | 449 | 71 | 12 | 1, 240 |
| 1 | 665 | 658 | 167 | 14 | 1, 634 |
| Average[2] | 645 | 582 | 113 | 24 | 909 |

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[1] Table taken from Supplement D, Industrial Waste Guides, U. S. Public Health Service, 194[illegible]

[2] Average weighted by plants.

Table 6.--Packingtown Testing station (Chicago)[1]; Results of various treatment processes.

| Determination | Effluent (parts per million) | | | | |
|---|---|---|---|---|---|
| | Raw waste | Screen | Imhoff tank | Trickling filter | Activated sludge |
| Ammonia nitrogen | 22.0 | 22.0 | 29.0 | 16.0 | 10 |
| Organic nitrogen | 79.0 | 75.0 | 60.0 | 20.0 | 10 |
| Nitrite nitrogen | .5 | .5 | .2 | 2.2 | 1 |
| Nitrate nitrogen | 3.0 | 3.0 | 1.7 | 16.4 | 5 |
| Oxygen consumed | 268.0 | 240.0 | 180.0 | 50.0 | ------ |
| Chlorine | 1,000.0 | 1,100.0 | 1,100.0 | 1,100.0 | 1,100 |
| Alkalinity | 212.0 | 212.0 | 240.0 | 200.0 | ------ |
| Suspended solids | 605.0 | 515.0 | 210.0 | 75.0 | 30 |
| Biochemical oxygen demand (10-day) | 990.0 | 930.0 | 630.0 | 120.0 | 50 |

[1] Table taken from Supplement D, Industrial Waste Guides, U. S. Public Health Service, 1943.

Disease/Solid Waste
Abstracts

No. DSW- 207

Author Stream Pollution Abatement Committee of the American Association of Textile Chemists and colorists, in Cooperation with the American Institute of Laundering

Title Commercial Laundering Industry

Reference U.S. Dept. of H.E. & W., Public Health Service, Bureau of State Services, Div. of Sanitary Engineering Services

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| PHS Pub. No. 509 | | 1956 |

Abstract

The soap or other detergent present in the water produces a rather permanent suspension of the soil and lint so that even after prolonged standing during which considerable bacterial decomposition will take place, there is only a partial separation of the solids.

TABLE 3. -- Typical Laundry waste water composition

| | |
|---|---|
| pH | 9.0 to 9.3. |
| Alkalinity above pH 7.0 as sodium carbonate | 60 to 250 p. p. m. |
| Total solids | 800 to 1,200 p. p. m. |
| B. O. D. (5-day demand) | 400 to 450 p. p. m. |

Gehm (5) states: "Laundry waste alone or combined with sewage can be readily and economically treated to any degree desired by existing physical, chemical and biological methods or by combinations or improvements of such methods." In support of this contention, it should be noted that most commercial laundry waste water is entered into the municipal sewage systems and apparently is causing little or no disturbance in the treatment plants. Accumulated sludge is either periodically pumped to drying beds or carted away in a semi-flued condition. An alternative is to provide at least two sets of primary settling ponds and to allow the aludge in one set of ponds to dry while the other set is being used for settling. The dried sludge is then removed mechanically and the ponds returned to service.

Summary: Surface waters can be contaminated by laundry wastes due to soil, lint, residual soap, alkali, starch, and other washable supplies normally present in such waste water. Appreciable waste reduction can be accomplished by avoiding overuse of washing agents and the control of washer loads in order to achieve the optimum ratio between washing agents and clothing load. A very large portion of commercial laundry wastes are discharged directly to municipal sewage systems and treated in admixture with domestic sewage. Considerable experimental work on the

Descriptors
detergent
bacterial decomposition
solids
sewage
sewage
sludge
primary settling ponds
alkali
chemicals
trickling filters
chemical flocculation
sedimentation
lagooning
sand filtration

separate treatment of laundry wastes with trickling filters if reported in the literature. In actual practice, some laundry wastes are being treated by chemical flocculation and sedimentation. Further purification may be obtained by lagooning and sand filtration.

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[5] Gehm, Harry W., Volume Characteristics and Disposal of Laundry Wastes. Sewage Works J. 16, 571-601, (1944).

Disease/Solid Waste
Abstracts

No. DSW- 208

Author Subcommittee on Dairy Waste of the Dairy
Industry Committee, in Cooperation with the Natio
Task Committee on Industrial Wastes

Title
Milk Processing Industry

Reference U.S. Dept. of H.E. & W., Public Health
Service, Bureau of State Services, Division of
Water Supply and Pollution Control

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| PHS Pub. No. 298 | | Revised 1959 |

Abstract

Processes in the milk and dairy products industry are potential sources of industrial waste in the form of waterborne milk solids in the plant drainage system. The wash water used in the regular cleaning of all milk equipment, containers, and plant floors, contains a small amount of milk solids.

Table MK--1.--Approximate average composition and Biochemical Oxygen Demand (B.O.D.) of some common dairy products[1]

| Dairy product | Butterfat (percent) | Protein (casein and lactalbumin) (percent) | Milk sugar (lactose) (percent) | Added sugar (percent) | Ash (percent) | Acidity as lactic (percent) | Total solids (percent) | Organic solids (percent) | B.O.D.[2] (percent) |
|---|---|---|---|---|---|---|---|---|---|
| Whole milk[3] | 3.9 | 3.2 | 5.1 | 0 | 0.7 | ........ | 12.9 | 12.2 | 10.3 |
| Evaporated milk | 7.9 | 6.7 | 10.1 | 0 | 1.4 | ........ | 26.1 | 21.7 | 20.8 |
| Separated milk | .1 | 3.3 | 5.3 | 0 | .8 | ........ | 9.5 | 8.7 | 7.2 |
| Nonfat dry milk solids | .9 | 36.9 | 50.5 | 0 | 8.1 | ........ | 96.4 | 88.3 | 73.7 |
| Sweetened condensed separated milk | .3 | 10.4 | 16.8 | 40 | 2.5 | ........ | 70.0 | 67.5 | 50.2 |
| Buttermilk[4] | .5 | 3.4 | 4.3 | 0 | .7 | 0.6 | 9.5 | 8.8 | 7.2 |
| Whey[5] | .3 | .9 | 4.9 | 0 | .6 | .2 | 6.9 | 6.3 | 3.5 |
| Cheddar cheese | 35.5 | 26.6 | 1.5 | 0 | 3.5 | ........ | 67.1 | 63.6 | 60.0 |
| Cream | 40.0 | 2.2 | 3.0 | 0 | .4 | ........ | 45.6 | 45.2 | 39.9 |
| Ice cream mix | 12.0 | 3.9 | 5.9 | 15 | .8 | ........ | 37.6 | 36.8 | 29.2 |

[1] Averages from various sources.
[2] Percent B.O.D. number of pounds of oxygen used by 100 pounds of product in 5 days at 20° C.
[3] Since the composition of whole milk varies considerably because of many factors, [illegible] values of individual samples may show considerable difference.
[4] Ripened cream buttermilk.
[5] American cheese whey.

Descriptors

industrial waste
milk solids
aerobic decomposition
anaerobic decomposition
sludge
pollution
purification
bacterial
aeration (modified activated sludge)
irrigation
biological filters
activated sludge
sludge
endogenous oxidation
oxidation
residual solids
acidity
alkalinity
biological filters
settling
trickling filters

The industrial waste from dairy plants consists of the waterborne milk solids which enter the drainage system. They are classified according to their source as follows:

1. Washings and rinsings from cans, equipment, and floors.
2. Spillage, freeze-on, overflow, and leakage due to worn-out equipment, and improper operation.
3. Entrainment from evaporators.
4. Byproducts, such as buttermilk, separated milk, and whey which have not been utilized.
5. Spoiled or damaged raw or manufactured products or byproducts.

When receiving waters cannot provide sufficient oxygen to maintain aerobic decomposition, the stream will not support fishlife. If this condition continues, anaerobic decomposition occurs and offensive black sludge is formed. The heavy black sludge deposits and strong pigpen odors caused by the putrefying casein are characteristic of milk waste pollution.

When a large volume of milk solids enters the sewerage system from one plant, it is probably done willfully in that no effort was made to keep such solids out of the sewer. Such action may cause an endless amount of trouble. If the discharge goes to a stream, it may so impede natural purification processes that the stream will become a nuisance; if discharged to a treatment system, it may disturb the normal bacterial activity of the system to such an extent as to put it out of commission. Refer to the section on "Utilization of Dairy By-products." Large volumes of milk solids should not be discharged directly to the sewer. A very small amount of milk solids (in dry form) will greatly increase the strength of plant waste.

The most important factor in waste saving and waste disposal is the complete utilization of all milk solids so that none will be discharged to the sewer. Several methods of treating dairy waste have been investigated and developed. At the present time, the most satisfactory means are aeration (modified activated sludge), irrigation, biological filters, and activated sludge.

Aeration (Modified Activated-Sludge-Type Treatment) These plants differ from activated sludge plants in that the sludge developed is aerated until stabilized, whereas in the activated sludge process, the sludge is removed to digestion units for stabilization or is disposed of otherwise. Extended aeration at a high rate results in the destruction of the cells by their own metabolism (endogenous oxidation), thus reducing the sludge volume as well as stabilizing it.

In the Fill-and-Draw Aeration system, the cell mass, along with the organic matter, is allowed to settle. The retained sludge (3,000to 15,000 p.p.m. suspended solids) is then aerated to satisfy oxygen requirements for stabilization and serves as seed for the next waste load. Some authorities believe that oxidation "burns up" all the sludge so that none remains for separate disposal (1), others claim that suspended solids in the effluent and foaming difficulties experienced at a number of these plants represent residual solids which would settle out in conventional activated sludge systems.

It was observed that all the sludge must be kept in continual circulation and that there be no dead spots where it can accumulate; that the aeration facilities be maintained in continual operation; that the solids of the mixed liquor be kept below 9 percent; and that a waste equalization tank ahead of the aeration tank was desirable to level out fluctuations in strength of waste, volume of waste, and excessive variations in acidity or alkalinity.

Biological filters have proven to be adaptable for treating milk waste that is diluted with processing waters. Suspended solids in the wastes may cause difficulties through clogging. Preliminary settling of the waste is desirable.

Activated sludge treatment is less elastic and shockproof than aeration or trickling filters. It has the advantage over trickling filters in that suspended solids of readily flocculated substances in the raw wastes do not interfere with operations.

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[1] Andersen, K. P., and Poulsen, P., "Investigations Into the Treatment of Dairy Waste Water in Septic Tanks," 13th Intern. Dairy Cong., 3, 986 (1953).

Disease/Solid Waste
Abstracts

No. DSW- 209

Author
I. M. Roberts

Title
Agricultural Solid Wastes

Reference

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| Unpublished | | May 20, 1965 |

Abstract

At present, and for the foreseeable future, crop residues such as cull vegetables, vegetable greens, as well as residual plants, are plowed back into the field. For the most part, this does not present a serious problem. The only areas where this technique cannot be used appears to be in the rice and barley crops, fruit and nut trees, prunings and brush, as well as in some cases involving plant sanitation. In these cases, the residues, at present are burned.

Any problems associated with the plowing of residues back into the soil are those associated with either mineral depletion or changes in the balance of the soil chemistry. Once the problem has been defined, it is a relatively simple matter to rectify the situation by the use of a combination of one, or many of the numerous agricultural chemicals readily available on today's market.

At present, approximately 90% of the rice stubble is burned in the field. In addition, it is estimated that 25% of barley stubble is burned. It is also estimated that approximately 50% of the residue such as prunings and brush from trees and nut orchards are being burned. It is estimated that 50% of all the manure produced is disposed of by spreading back on the field. The other 50% is produced at the urban-rural interface and poses a special problem.

The major problem found in the previously described urban-rural interface, is one associated with the production of manure by dry lot dairies and chicken farmers. There are a number of reasons why this manure production represents a serious problem. These are: animal health, wholesome food production, efficient operation, land improvement, aesthetics, and probably most important, the fact that fresh, moist manure is a prime culture media for fly breeding. When the average temperature is above 65°F, and flies are active, the fly eggs will hatch within 24 hours into fly larva or maggots. Under ideal conditions, the maggots go through their three larval stages in five to six days. After an additional two to three days in the pupa stage, the adult fly is ready to repeat the life cycle. The most effective fly control method would therefore be to break the cycle so that manure is not available for the fly to lay eggs in, or if the larvae

Descriptors

crop residues
manure
spreading
fly breeding
fly larva
maggots
disposal
soil conditioner
disease
air pollution
pesticides
insecticides
toxicity
detergent

were prevented from completing their growth within the manure.

A major step towards solving the manure and its associated fly breeding problem would be a statewide requirement for the clean-out of corrals and chicken houses within a ten-day period. This would effectively break the breeding cycle of the fly. Once the manure has been collected, it is necessary to dry it to at least 35% moisture content, in order to break the cycle.

The major crop waste disposal problems are from those crops whose wastes are not amenable to being plowed back into the soil. The field stubble left after the harvesting of rice and barley crops is highly cellulosic, and as such is only slowly decomposed after being returned to the soil. This problem is compounded by the fact that the materials are prone to have a deleterious effect upon the soil. Another problem is the disposal of rice hulls which constitute 20% of paddy rice. These hulls are high in silica, slow to decompose, and under present practice of burning in piles, burn very poorly and tend to smoulder over a long period of time. Another area contributing to the agricultural burning problem is the disposal of prunings and brush from the fruit and nut orchards.

1. Barley field stubble was burned from 25% of the total acres planted.
2. Rice stubble was burned from 90% of the total acreage planted in rice. The yield of stubble is 3.5 tons per acre. 20% of the rice yield is hulls and all of the rice hulls are burned.
3. Orchards. One tone of prunings, brush, and removed trees are obtained per acre of orchard. Of this total, 90% is burned.

It may be possible to bale the field straw and sell it for cattle feed. However, it is believed that this rice and barley straw will be of only marginal utility and not competitive with the alfalfa grown in the rest of the State. The primary reason that rice and barley stubble cannot be plowed back into the soil is due to the extremely high carbon and low nitrogen content making this material extremely difficult to decompose. One solution, as suggested in the previous section, would be the spreading of manure, from the livestock farmer of the urban-rural interface, over the rice and barley field just prior to plowing the mixture back into the ground. Suitable selection of the quantity of manure would give a proper misture in the soil for in situ compost.

Machinery is now available that will chop or shred prunings and brush into a condition that will enable it to be disced or mulched into the soil. This material serves as an excellent soil conditioner, especially in heavy or very light soil. The machinery is capable of handling prunings up to 3 inches in diameter and has found ready acceptance.

Present plant sanitation procedures call for burning the diseased trees and limbs not only for the purposes of disposal but also to prevent the spread of the disease throughout the orchard. It is possible that the application of chemical digestion and field incinerators may alleviate not only the disease problem but also the air pollution which occurs due to the present method of disposal.

Pesticides are being found on the foods that reach the fresh produce market, and in cases where the crop residues are plowed under the insecticides eneter the soil along with the crop residues. These pesticides are then, in turn, leached out into the soil, and eventually through one means or another, find their way into our underground water supply or our surface streams.

While it is necessary that the work in progress concerning the determination of chronic toxicity characteristics of pesticides be continued and probably carried to an even higher level of effort, there is another approach that might be profitable. As a result of the threat of legislative regulation, the detergent manufacturers were able to develop biodegradable detergents within a relatively short period of time. There is no reason to doubt that the agricultural chemical manufacturer, under the same type of pressure, might be able to develop biodegradable classes of pesticides. Still another possibility along these lines would be to investigate the development of kinetically unstable materials that will decompose into innocuous compounds after one week of exposure to sunlight and atmospheric moisture. It is generally conceded that any pesticide that has not done its work within one week, it is not going to do it at all. The development of materials of these general characteristics would put an end to the present concern over the increasing amount of pesticides that are finding their way into our food and water supplies.

**Disease/Solid Waste Abstracts**

**No.** DSW- 210

**Author**

Frank M. Stead

**Title**

Social and Legal Implications of Organic Waste Management

**Reference**

Compost Science, Aut-Win. 1965, Vol. [illegible]. No. 3., pp. 11

**Doc. No.** **Contract No.** **Date issued**

**Abstract**

I believe that the only tenable assumptions in the years ahead are

1. The environment will be increasingly man-dominated, and the only choice is between good management or catastrophic destruction of our real wealth

2. Organic material is probably man's greatest resource and we must approach its management from the point of view that it is a vital part of the machine of life, not a useless waste product.

3. The greatest good for all must be the criterion in balancing of equities between private enterprise and the public interest.

We must realize that the problem of environmental health has striking similarities to that of human health, that the processes of conversion of organic matter are merely extensions of processes that take place in the human body.

**Descriptors**

environmental health
human health
organic matter
management
resource
waste
private enterprise
public interest

No. DSW- 211

Author U.S. Dept. of H.,E., & W., Public Health Service

Title Activities Report, Basic and Applied Science Branch, Division of Water Supply and Pollution Control July 1, 1963-June 30, 1964

Reference

Doc. No. | Contract No. | Date issued 1964

Abstract

The health hazards of the sewage treatment plant workers were studied and a paper, "Health Aspects of Wastewater Treatment" was presented and published on this subject at the request of the Safety Committee of the Water Pollution Control Federation. Data on the subject are meager but enough was gathered to indicate a probable increased risk to the workers in contracting leptospirosis and infectious hepatitis over the risk of the general population. Future studies to substantiate the impression have been outlined and will be undertaken within the next year.

Some multiple regression analyses have been made on the relation of cardiovascular disease mortality and dissolved solids in drinking water of the metropolitan areas of the country. Interpretation of the role of drinking water in the causation of heart disease must await complete analyses of the effects of other social, economic, and environmental variables.

Stream pollution purposes will not be served unless the separated contaminants are disposed of in some permanent or ultimate manner. This disposal represents a cost and must be accounted for in the total waste-treatment and water-renovation system. However, disposal costs do not appear large compared to the other treatment costs. Several ultimate disposal processes have been studied.

Wet Oxidation -- Already in use is the wet oxidation process to treat sewage sludge by aqueous combustion. This high-temperature and pressure process would be able to accept a wide variety of organic wastes.

Incineration -- Organic materials can be destroyed by injection into a furnace. A high concentration of combustible solids is required.

Injection -- Injection of industrial wastes into porous underground formations is currently practiced. Very careful assessments of areas where this can be done without hazard offers one possible way to dispose of AWT wastes.

Placement in Underground Cavities -- Underground cavities may be a possible storage area for waste concentrates. Natural cavities or those man-made for other purposes would likely be used. It would not be economical to construct such

Descriptors

E. Epidemiological
sewage
wastewater
pollution
leptospirosis
infectious hepatitis
cardiovascular disease
dissolved solids
disposal
contaminants
wet oxidation
aqueous combustion
organic wastes

incineration
combustible solids
injection
waste concentrates
conveyance
molds
yeasts
sludges
fungal
digestion
sludge digester
primary settling tanks
acid mine drainage

sediments
sanitary sewage
anaerobiosis
Geotrichum candidum
Trichosporon cutaneum
Phialophora jeanselmei
Aureobasidium pullulans
Aspergillus niger
Phoma herbarum
anaerobic
Aspergillus sydowii
aerobes
phenol

hydrocarbons
2,4,6-trichlorophenol
bacteria
chlorinated hydrocarbon pesticides
aldrin
dieldrin
heptachlor
chlordane
endrin
toxaphene
methoxychlor
DDT
2,4-D
(see page 6)

cavities except by nuclear mining techniques.

Conveyance -- Wastes are not conveyed to the oceans by surface streams. Concentrates could be hauled or otherwise moved to the ocean for final disposal. ,

Molds and Yeasts in Sludges -- Samples of primary settled sludge, and settled activated sludge were studied to determine the fungal (mold and yeast) populations at the stages of sludge digestion represented by the experimental sludge digesters used in the sludge digestion experiment. It was found that molds and yeasts persisted throughout the stages being studied regardless of levels of oxygen present in the sludge digesters at various stages of the process.

A sludge digester was set up to which, after it was brought to equilibrium with unsterilized feed from primary settling tanks fortified with fish meal, only sterile fish meal was added for at least seven turnovers of a 16-day retention time system. At the end of this period the digester was still functioning properly; mold and yeast colony counts and indicated numbers were still high.

Acid Mine Drainage -- Work has been initiated in an attempt to delimit the population of fungi associated with creek, river water, sediments and associated soils. Early sampling was carried out in the spring of 1954 when a number of species of molds usually associated with stream bottom and bank sediments were found in streams draining into the Hocking River in eastern Ohio. A set of samples of water from the Monongahela River survey in 1963 were processed and results showed that some fungi were present but sampling and carrying techniques were inadequate and gave only a very rough idea of populations potentially involved.

A set of samples was obtained in a series of stations in the Monongahela River drainage near Morgantown, W. Va. These samples yielded a large number of molds and yeasts, more appearing in portions of the stream more heavily loaded with sanitary sewage, but even where stream banks were composed almost exclusively of gob piles some fungi were present. In general, it may be said that as pollution increases the numbers of species and of colonies increases, but where pollution is severe, and sanitary sewage is negligible, numbers of species and colonies decrease. Beyond an undetermined point, numbers of colonies increase but numbers of species level off or decrease. Populations in the immediate vicinity of acid mine drainage waters appear to be somewhat different than those of soils on creek banks which may be affected only briefly by such waters during floodtime.

Oxygen Requirements of Fungi and Anaerobiosis -- Experiments have been initiated to determine in pure culture certain nutritional requirements of commoner fungi associated with sewage and Phialophora jeanselmei, Aureobasidium pullulans, Aspergillus niger, and Phoma herbarum have been tested to date. Because of the occurrence of fungi in sludge in which no measurable oxygen occurs, a search was made for an opportunity to observe growth of fungi under anaerobic conditions. This search proved essential when a sewage effluent sample developed a mold cortaminant in an anaerobic jar. The mold was tentatively identified as Aspergillus sydowii and is one of three fungi that is being grown in an anaerobic incubator or anaerobic jars in an atmosphere devoid of measurable oxygen. These fungi have been growing for at least 25 days under these conditions. These observations indicate that the classical textbook statement that all fungi are aerobes may well have to be revised.

Adaptation of Microorganisms to Degrade Wastes: Of the 12 cultures investigated the one adapted to phenol has shown the greatest ability to utilize other hydrocarbons. Because of the high general activity of the phenol culture and the fact that 2,4,6-trichlorophenol is the most highly chlorinated phenol to which we have specifically adapted bacteria, the cultures adapted to these two compounds were selected for initial respirometric tests with chlorinated hydrocarbon pesticides, both cultures were used in tests with aldrin, dieldrin, heptachlor, chlordane, endrin, toxaphene, methoxychlor, DDT, 2,4-D, BHC, sevin and TDE. Under the conditions of our tests none of these pesticides were measurably degraded.

Cultures to degrade two standard "soft" detergents provided by the SDA have been developed from raw sewage and activated sludge.

The SDA Shake Flask Procedure utilizes a medium that is rich in an accessory nutrient--yeast extract. This medium produces a heavy cell crop in the absence of any ABS and has been compared in parallel tests with the mineral salts medium used in our investigation of the degradation of aromatic hydrocarbons and pesticides. The most significant difference between the SDA medium and the mineral salts medium is that in the latter the ABS being tested is the sole source of carbon for bacterial growth.

At a given initial ABS concentration in both media, with equal number of cells inoculated in both media, degradation progresses more rapidly in the minderal salts medium.

Nitrate accumulation, a common problem, interferes with chlorination. Very recently marked progress has been made in achieving complete nitration by building and maintaining a large sludge mass.

Two effective conditioning procedures have thus been demonstrated:

Oxidation with nitrite formation completely inhibited--Inhibition has been easily achieved with 2-chloro-6 (trichloromethyl) pyridine. Conditioned sewage treated with 3 to 5 ppm chlorine generally develops a stable 1 ppm chlorine residual that gives 99.9 percent destruction of E. coli in about 20 minutes. Longer treatment gives bacteriologically sterile effluent. The presence of ammonia limits the process to chloramine killing rates. Activated sludge treatment of the chlorinated sewage leads to a detoxified effluent. Nitrite formed on oxidation quenches the chlorine.

Oxidation with complete nitration--Preliminary success in developing a reliable process promises marked improvement in chlorination because ammonia is eliminated and much faster disinfection is made possible. A number of secondary benefits are promised. The efficient aerobic system eliminates many toxic organic substances and many compounds that form toxic comginations with chlorine. Both procedures set up conditions that permit elimination of all bacterial pathogens by chlorine.

A cooperative study was conducted on the efficiency of ultraviolet radiation in the treatment of artificially polluted waters under laboratory controlled conditions. Test organisms included pure cultures of E. coli, A. aerogenes and S. fecalis as well as polioviruses, types I, II, and III, ECHO 7 and Coxsackie A9 virus. The results of these studies indicated that the treatment unit would disinfect water to meet bacteriological standards for drinking water if factors affecting transmission did not lower the intensity of the ultraviolet energy below a specific value on the experimental test meter and if the designed flow rate of the apparatus was not exceeded.

An extensive literature review of over 400 articles showed that the use and variety of pesticides are increasing and their persistence in the soil and water is cause for concern to public health and water resource officials. Pilot plant and jar test studies were, therefore, made with river water to determine which pesticide each unit process would remove. This study started with a dose of 1 microgram per liter of six common pesticides and increased stepwise to 10 micrograms per liter. The objective was to use certain treatment processes to reduce the quantity of pesticides to predetermined levels such as 1.0, 0.1, and a minimum detectable level of 0.01 micrograms per liter. The cummulative removals experienced from 1 year of pilot plant operations indicate the following:

Since DDt is relatively insoluble in water, it was easily removed by a combination of settling and coagulation followed by filtration. Lindane and parathion were not reduced significantly by these conventional processes.

Chlorine and potassium permanganate in the 1 to 5 milligrams per liter (mg/l) level did not reduce chlorinated hydrocarbons. These oxidants did convert parathion to a compound toxic to mammals.

At high impractical levels only ozone did reduce the chlorinated hydrocarbons, somewhat, but the by-products formed and their toxicity are not known.

A powdered activated carbon slurry greatly reduced all of the six pesticides tested in river water. Only 5 to 10 mg/l were needed to achieve 99 percent removal of parathion; however, greater doses were necessary for similar removal of lindane and dieldrin.

Fresh, granular activated carbon beds were able to reduce pesticide concentrations to the detectable level of 0.02 micrograms per liter.

Even when exhausted by the usual COD, CCE, and odor criteria, the carbon bed was able to remove a majority of a chronic pesticide load.

Considerable progress has been made in evaluating various coagulation-filtration systems for removing particles from secondary sewage effluents. Pilot plant operations indicate that this approach should extend the life of electrodialysis membranes or activated carbon beds.

An extensive field study of four municipal treatment plants was carried out to ascertain the effects of the heavy metals copper, chromium, nickel, and zinc on actual operating plants' processes. At the time of the study these plants had an influent total metal concentration of approximately 2,9,3, and 7 mg/l respectively.

Pilot studies had indicated that municipal plants receiving metals in the above range would not suffer any great loss in overall efficiency of the process.

The efficiency of the various municipal plants in removing the metals varied considerably between plants, but at each plant zinc was most effectively removed and nickel least effectively, as predicted by pilot-plant experience.

The municipal anaerobic digester showed no effects attributable to the metals. Grand Rapids, with the highest metal content in the digesters, had the best anaerobic digestion. Pilot-plant digesters operated at metal concentrations even higher than Grand Rapids had proved satisfactory.

In the field study at the Bryan plant, 50 pounds of hexavalent chromium were dumped from a plating waste tank into the municipal sewer. The effects and the distribution of the chromium were followed through the treatment plant. The highest concentration of chromium in the influent sewage at the peak was 410 mg/1. The study indicated no adverse effect on the activated sludge process of anerobic digestion. A previous pilot-plant study of the effect of chromium on the activated sludge process indicated that this level of chromium would not adversely affect the processes.

Incidental to this planned slug of chromium a slug of copper cyanide hit the plant several days later. Examination of the daily reports of the plant and analysis of digester samples for 30 days after these slugs showed no adverse effect.

The data of the field study correlate well with previous pilot-plant studies, and there is now available firm information to advise municipalities on the effects plating wastes would have on their treatment procedures.

A pilot-plant study on organic load and the toxicity of copper to the activated sludge process was completed. The results of the study indicated that for the same concentrations of copper in the influent sewage its toxicity was increased slightly at a lower organic loading. Organic load also slightly affected the fate of copper through the process outlets.

Descriptors (Continued from page 1)

BHC
sevin
TDE
The SDA Shake Flask Procedure
mineral
salts medium
nitrate accumulation
chlorination
E. coli
ammonia
chloramine
toxic
bacterial pathogens
ultraviolet radiation
A. aerogenes
S. fecalis
polioviruses
settling
coagulation
filtration
Lindane
parathion
ozone
carbon slurry
electrodialysis
copper
chromium
nickel
zinc
hexavalent chromium
plating waste
copper cyanide

Disease/Solid Waste
Abstracts

No. DSW- 212

Author S. H. Jenkins

Title The Composition of Sewage and its Potential Use as a Source of Industrial Water - Re-use of water in Industry, Part 2.

Reference
Chemistry and Industry

| Doc. No. | Contract No. | Date issued |
|---|---|---|
| n V.50 pgs. 2072-9 | | Dec. 15, 1962 |

Abstract

More total solid is present in sewage from hard than from soft water districts. In a soft water area the sewage contained an average of 937 ppm total solid and 1515 ppm in a neighbouring works where the water supply was hard.

The composition of the matter present in domestic sewage is extremely complex. Urine contains nitrogen compounds which include urea, creatinine, uric acid, hippuric acid, ammonia and amino acids together with sodium, potassium, calcium and magnesium, chloride, sulphate in the organic and inorganic form and phosphate.

Faecal matter contains proteins and carbohydrates of bacterial origin, fats, soaps, fatty acids such as stearic acid, lignin, and undigested celluloses, cholesterol, phospholipids.

Domestic sewage also contains cellulose derived from toilet paper, animal and vegetable fats, proteins, starches, soluble carbohydrates and plant celluloses, salt alkalis, soaps, detergents from kitchen waste and ammoniacal and nitrogenous compounds from laundered articles.

From industrial processes the chemical composition of the waste waters may be even more complex. They may contain whole milk or whey from milk bottling or processing; alcohol, organic acids, proteins and carbohydrates from brewing industries; milk products and sugars from chocolate manufacture; phenolic compounds, alcohols, formaldehyde, urea, vinyl derivatives and numerous inorganic chemicals from the manufacture of pharmaceuticals, rubber accelerators and plastics; iron salts, acids, heavy metals and cyanides from the anodising of aluminium and the plating of metals; phenols, thiocyanates, ammoniacal compounds and so-called higher tar acids from the manufacture of coal, gas or coke; solvents and resins from the preparation of adhesives; hemicelluloses, lignin, alkalis and bleach liquors from the manufacture of paper and paper board; oils and oil additives from engineering industries . . . . . the list is almost inexhaustible.

These substances occur in low concentration in sewage since the total weight of solid does not usually exceed 1000-1500 parts of solid per million. Detailed chemical analysis of such mixtures is a formidable and generally unrewarding task

Descriptors

Sewage
solid
urine
urea
creatinine
uric acid
hippuric acid
ammonia
amino acids
faecal matter
stearic acid
lignin
undigested celluloses
cholesterol
phospholipids
detergents
kitchen waste
ammoniacal
nitrogenous compounds
phenolic compounds
alcohols
formaldehyde
cyanides
phenols,
thiocyanates
tar acids
hemicelluloses
alkalis
bleach liquors
organic impurity
centrifuging
ultra filter
micro-organisms
trade wastes
pH
Suspended solids
alkalinity
permanganate value
biochemical oxygen demand
nitrogen compounds
organic carbon
chemical oxygen demand
dichromate value
oxidisable organic matter
phosphorus
synthetic detergents
biological oxidation
sludge
metallic constituents
metallic salts
ultimate oxygen demand
bacteria

(see page 5)

and it has only been attempted for special purposes, such as to provide a broad classification of sewage constituents and their distribution between the liquid and the solid phase, and to determine the extent and fate of potentially harmful substances.

A considerable part of the organic impurity in sewage is insoluble. This was demonstrated by Mills who showed that on filtering sewage from one treatment works through an ultra fine membrane capable of retaining highly dispersed proteins about 30% of the organic carbon and 50% of the organic nitrogen were found in the filtrate; the organic carbon and nitrogen compounds in suspension were quickly sedimented by centrifuging.

More recently Heukelekian and Balmat[1] have determined the composition of sewage--insoluble matter which represented about 36% of the total solid content. The solid matter was fractionated into easily settleable matter above 1μ in diameter, solid matter between 0.1μ and 1μ and the solids collected when the remaining sewage was filtered under pressure through an ultra filter. Solids collecting on the ultra filter contained 11.7 ppm of mineral matter, expressed in terms of the 14 elements determined, compared with 82.3 ppm in the soluble fraction. Saturated and unsaturated free fatty acids, glyceride fatty acids, phospholipids and unsaponifiable matter were found in the ether extract of the various solid fractions. Hydrolysis of the organic nitrogenous material in the solid yielded fourteen aminoacids. Pectin, hemicellulose, cellulose and lignin were also present. The sewage solids did not remain constant in composition but varied quantitatively during the day, between Monday and other days and between summer and winter.

From results obtained by Painter[2] the daily average composition of sewage from the residential area of a new town was equivalent to 0.012 lb. ammoniacal nitrogen per person, 0.0054 lb. organic nitrogen, 0.056 lb. organic carbon excluding urea, while the BOD yield was 0.1 lb. per day.

In considering the composition of sewage an important factor is the presence of micro-organisms capabde of utilising sewage constituents for their growth, thus changing the composition of the sewage. These micro-organisms are derived from the drinking water which, except when ozonised, is rarely completely sterile; by ground and surface water entering the sewers; by the introduction of intestinal organisms from faecal matter; by trade wastes from breweries, milk processing factories abattoirs, food factories and chemical works. The high dilution of the organic constituents and the narrow, somewhat low temperature range favours some micro-organisms and discourages others. Since the organisms are capable of rapid multiplication given suitable conditions, changes in the composition of the sewage can take place in a short time. Such changes may occur during the time the sewage is flowing to the treatment works. The rate of decomposition is greatly influenced by temperature; the optimum temperature for the growth of micro-organisms varies according to species but for those in sewage this temperature is about 30°C. In this country, the normal range of temperature of sewage at treatment works is 6° to 26°C. but higher temperatures may be observed in sewers which receive discharges of warm trade effluents.

In view of the chemical complexity of sewage it is impracticable to determine the concentration of individual constituents. Instead, the general properties of the sewage are measured by simple analytical procedures that might be termed sanitary methods.

(1) pH--Sewage when fresh has a pH within the range 7 to 8 5.

(2) Total Solids--The total solid content, as already mentioned, is about 400-1000 ppm depending upon the water supply and water consumption.

(3) Suspended solids. The determination is important because of the large proportion of total impurity in the insoluble form.

(4) Alkalinity -- Sewage has an alkalinity of about 250 to 500 ppm expressed as the equivalent calcium carbonate. The sources of alkalinity are the calcium salts, ammonium compounds, proteins, alkalis in soap powders and soaps.

(5) Permanganate Value (Oxygen Absorbed).-- In this test the reduction of a standard permanganate solution in acid solution for four hours at 27°C. is used as a measure of the organic content of the sewage.

(6) Biochemical Oxygen Demand -- This is a measure of the organic matter which can be oxidised biologically.

(7) Nitrogen Compounds--In sewage the nitrogen compounds are present in the organic form or as ammonium salts. The ammonium compounds are derived from urea which is rapidly hydrolysed by bacteria. The sum of the organic and ammonium nitrogen gives a useful indication of the polluting of the sewage which has been derived from the excretory products.

(8) Organic Carbon; Chemical Oxygen Demand; Dichromate Value-- The total amount of organic carbon may be determined by wet oxidation with sulphuric acid and dichromate, with absorption of the $CO_2$ formed by baryta. The chemical oxygen demand and dichromate value are both tests in which the amount of dichromate reduced under standard conditions is used to measure the content of oxidisable organic matter.

(9) Phosphorus--Phosphorus compounds in sewage are mainly derived from domestic sewage and are present in the organic and inorganic forms.

(10) Synthetic Detergents-- These are an important constituent of sewage since they contribute organic compounds which are more resistant to biological oxidation than the domestic sewage components; to some extent they interfere with sewage purification and sewage sludge treatment processes.,

The results of treatment vary somewhat according to the composition of the sewage, the type of plant used and the rate of treatment. Table III indicates the composition of effluent that might be expected from a plant operating within its capacity.

Pg. 2077

Effluents which comply with the so-called Royal Commission standards may not be sufficiently well purified to avoid causing pollution under certain conditions. Further purification may then be effected by one of several methods.

The final effluent may be stored in a lagoon holding several days' flow. The object of lagooning is to allow self-purification of the effluent to take place.

Solid matter which may decompose is deposited in such lagoons so that arrangements are required to remove deposited sludge. Filtration through a shallow bed of sand improves the quality of final effluents by removing suspended solid matter and some of the dissolved organic matter. Grass land is capable of removing soluble and suspended organic matter from sewage effluent irrigated gently over the surface. Uniform distribution of the flow and a gradually sloping area are required. San filtration and grass land treatment are capable of producing effluents with about 5 or 6 ppm of suspended solids and a BOD of 7 or 8 ppm. It should be noted that purification reduces the synthetic detergent content of sewage from about 13 ppm to 5 ppm. When the detergent concentration exceeds 0 5 ppm effluents are likely to foam on aeration.

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Descriptors (continued from page 1)

bacterium
effluent
pollution
lagoon
filtration
sand filtration
grass land treatment
aeration

Disease/Solid Waste
Abstracts

No. DSW- 213

Author F. R. Bowerman and Franklin D. Dryden

Title
Garbage, Detergents, and Sewers

Reference
Journal WPCF

Doc. No. Contract No. Date issued
Vol. 34, No. 5, pps. 475-494 May 1962

Abstract

Synthetic detergents have had a profound influence on treatment processes, particularly the activated sludge process, and have caused great concern as to the possible pollution of groundwaters. Of further interest to sanitary engineers is the role of synthetic detergents in emulsifying and dispersing the grease components of sewage. Careful and serious thought is now being given to the possibility of adding ground organic refuse to sewers rather than separate disposal by incineration or landfilling. Such combined sewage-garbage-refuse systems would require large increases in sludge disposal facilities at treatment plants, for it is estimated that an increase in suspended solids concentrations of as much as 500 percent could occur if all organic refuse were added to the sewage.

Lakewood, Calif., with a population of over 100,000 residing in 27,000 homes, is an area totally dependent on the sewerage system for the disposal of garbage. It is one of the largest housing complexes in the world with no alternative method of disposing of garbage other than the sanitary sewerage system.

The major problem resulting from the use of grinders has appeared to be the substantial increase in grease. There is more grease in sewage and it is causing some problems. The collection system problems are of three types: (a) accumulation of grease along the sides and crowns of sewers and inverted sewer siphons, resulting in a maintenance problems; the accumulations of grease in force mains causes a reduction in capacity by increasing friction.

One unusual fact about grease composition in sewers is that the basic composition of these deposits now is very similar to that of twenty years ago in spite of the fact that detergents have replaced so much of the previously used soaps. It is theorized that the initial role of detergents in this process is to maintain grease in a dispersed and colloidal state, thereby allowing for bacterial enzyme action, which reduces a glycerine molecule from the fatty acid leaving the fatty acid free to react with the calcium and magnesium ions in the sewage flow, forming insoluble calcium and magnesium soaps. These insoluble soaps in small globules can agglomerate with other grease deposits along the

Descriptors

garbage
detergents
sewers
synthetic detergents
treatment processes
activated sludge process
pollution
grease
organic refuse
incineration
landfilling
sewage-garbage-refuse systems

sludge disposal facilities
suspended solids
organic refuse
sewage
disposal
grinders

collection system
colloidal state
bacterial enzyme action

side walls of the sewers and build up large accumulations in spite of high velocity flows.

The food waste grinder is a practical, sanitary method for disposing of household and restaurant garbage.

Detergents, as well as grinders, appear to play an important role in the buildup of grease deposits in sewers.

Disease/Solid Waste
Abstracts

No. DSW- 214

Author
Robert N. Rickles

Title
Waste Recovery and Pollution Abatement

Reference
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Sept. 27, 1965

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|---|---|---|
| | | Sept. 27, 1965 |

Abstract

Many industrial wastes contain solids and colloids, which may be removed for reuse or disposal by the application of gravitational forces or blocking functions.

Gravitational systems depend on the tendency of particles to settle at rates dependent both upon their size and the specific gravity differential between the particle and fluid. This principle is applied in equipment such as:

Sedimentation tanks,[90, 102] which are continuous flow systems designed to effect sedimentation and solids withdrawal.

Thickeners,[90,95,102] in which the solids-laden stream is carried through a blanket of previously collected solids.

Flocculation tanks,[90] in which chemicals are added to improve--or make possible--the separation of colloids and other solids. This function is performed by the creation of large flocs or by the neutralization of surface charges on the colloids.

Cyclones,[72, 90] in which a multi-gravitational force is applied to a stream by introducing the pressurized stream tangentially to an inverted cone.

Centrifuges,[72,90] which produce a multi-gravitational force by acceleration of the feed.

Solids may be separated by blocking, in which a system interferes with their passage in the carrier medium. Some equipment for doing this:

Screens containing a preformed, perfectly regular set of holes of relatively large size, and operating at low pressure drops.

Filters[32] containing a preformed, or continuously formed irregularly shaped set of holes of relatively small size, in the form of a fibrous woven or unwoven sheet, and operating at relatively high positive or negative pressures.

Sieving membranes,[43] which are plastic sheets containing extremely fine holes to remove colloids, bacteria and the like.

Descriptors

waste
pollution
industrial wastes
solids
colloids
disposal
sedimentation
thickeners
flocculation
cyclones
centrifuges
blocking
screens
filters
sieving membranes
bacteria
emulsions
centrifugal
electrical forces
foaming
flotation
adsorbents
solubles
adsorption
effluents
ion exchange
chromic acid
cyanide wastes
metals
ionized organics
membrane processes
dialysis
electrodialysis
reverse osmosis
ultrafiltration
solvent extraction
amonia-still wastes
phenol
wool wastes
wool grease
pulping liquors
acetic &
formic acids
crystallization
pickle liquors
waste brines
ultimate disposal
concentrated liquid wastes
thermal oxidation
seawater brine
organics
organic-inorganic mixtures
biological oxidation and
reduction
sewage sludge
fertilizer
inorganic wastes
deep-well injection
encapsulation
salt cavern storage
short-term lagooning
thermal loading
(see page 10)

Such systems are also used to separate liquid mixtures and emulsions; it is necessary to "break" emulsions before or during the separation. This may be accomplished by the application of heat, centrifugal or electrical forces, or properly wetted surfaces.

In foaming, soluble surface-active agents gather at the solvent-air interface, and the presence of air bubbles produces a foam, which may be removed.

In flotation, air bubbles attach themselves to solids and carry them to the surface.

The contact between waste streams and high-surface-area commercial adsorbents will result in the removal of solubles (from the waste) as an adsorbed layer on the solids.[65]

Adsorption may take place in columns, filters, agitated tanks or pipelines.

Adsorption has been used in the treatment of organic-containing effluents from laundry, sewage, organic chemical and dye works, and in the removal of metal ions from plating baths.

Ion exchange is the reversible exchange of ions between a solid and liquid, in which there is no substantial change in the structure of the solid.

Ion exchange has found application in the:

Recovery of chromic acid from cooling tower effluents.

Treatment of cyanide wastes.

Recovery of metals from plating baths.

Treatment of low- and medium-level radioactive wastes.

Recovery of isotopes from high-level radioactive wastes.

Recovery and removal of ionized organics from aqueous solutions.

Membrane processes[41] may be widely applicable to waste treatment. Three important processes are:

Dialysis, which employs concentration driving forces and makes separations on the basis of molecular sizes, or diffusion rates in the solvent.

Electrodialysis uses electromotive driving force. The ability of membranes to selectively pass either cations or anions is of primary importance.

Reverse osmosis, or ultrafiltration, uses a pressure gradient to make a separation based on the relative solubilities and diffusivities in the membrane of the various liquid-phase components.

Solvent extraction is not often used in waste treatment since it is expensive and not well suited to either treat large and varying volumes of liquid or remove trace quantities. However, solvent extraction is applied to amonia-still wastes to recover phenol, wool wastes to recover wool grease, and pulping liquors to recover acetic and formic acids.

Crystallization is involved in processes developed to treat pickle liquors and waste brines.

Ultimate disposal must be used for solid or highly concentrated liquid wastes that cannot be used or recovered. A large number of ultimate disposal methods are available, and the choice depends on waste characteristics, economics and local regulations. A number of carefully developed studies have been made to determine the optimum means of disposing of wastes such as sewage effluent concentrate and seawater brine.[27, 57] Methods of ultimate disposal include the following:

Thermal oxidation--useful for organics and for stabilizing organic-inorganic mixtures.

Long-term biological oxidation and reduction--often not purposefully done, but a natural consequence of other actions such as the use of sewage sludge for fertilizer.

Return to soil in a stabilized form--useful for most inorganic wastes.

Disposal into rivers, lakes, bays and other non-sink water bodies--a common but usually undesirable method.

Disposal into the ocean--common practice for plants and cities located near the ocean. The effect upon the ocean is not clear.

Deep-well injection--an extremely promising technique limited only by geology.[106]

Encapsulation--limited to radioactive wastes.

Salt cavern storage--under study for nuclear wastes.

Long-term tank storage--practical only for high-level nuclear wastes.

Short-term lagooning--useful for reducing organic, nutrient and thermal loading, but not a true ultimate disposal method.

Solids Separations--Methods for removing solids from gas streams under a variety of conditions are well known[27,87,103,111] and widely practiced.

Gravitational force--simple settler.

Multi-gravitational force--cyclone.

Interference--gas filters.

Contact with a liquid phase (scrubbing)--venturi scrubbers, etc.

Other external forces--electrostatic precipitation, ultrasonics, etc.

The petrochemical industry has largely been successful in reducing its pollutant load by using organic wastes as fuel until a higher market value develops, and by pursuing a vigorous research and marketing program to develop recovery processes and expand markets for recovered chemicals.

Wet scrubbing is used to remove $CO_2$ and $H_2$ streams in conventional synthesis-gas plants.

Adsorption on molecular sieves or activated carbon is used to separate hydrogen from hydrocarbons.

Cyrongenic scrubbing removes higher-boiling impurities by condensation from low boiling hydrogen (-252.8C).

Membrane permeation, based on palladium's selectivity in passing hydrogen, is used to recover hydrogen from petroleum effluents.

Inorganic acids used or produced in petrochemical processing create a serious waste-disposal problem. So severe is the problem of hydrochloric acid disposal for producers of vinyl chloride and chlorinated hydrocarbons that considerable efforts have been expended towards the development of oxychlorination processes that enable the producer to use HCL in place of chlorine. More will be said about this later.

Distillation is used to recover: chlorinated hydrocarbons following the chlorination of methane; olefins from the thermal production of ethylene; acetaldehyde following the production of vinyl acetate; and solvents from rubber latexes.

Crystallization is used to separate xylene from ethyl benzene.

Adsorption is useful for the recovery of carbon disulfide, carbon tetrachloride and other solvents.

Extraction is sueful for the recovery of isobutylene, naphthalenes, paraffins and phenol from a variety of wastes, and organic dyes are extracted following adsorption of fuller's earth.

Ion exchange recovers basic amino acids, amines, alkaloids and organic acids.

Oxidation regenerates spent caustic.

The coke and gas industry makes substantial byproduct recovery including amonium sulfate, coal tars and oils, and coal gas, all from gaseous coke-oven effluents.[44]

Phenolic-containing liquors are a significant disposal problem since they impair the taste of the receiving waters, especially if chlorinated. Solvent extraction (with benzene), activated-carbon adsorption, steam stripping, and ion exchange have been employed to recover phenol from these liquors.

The inorganic chemical industry's disposal problems center on the treating of: sulfuric acid wastes; hydrochloric acid and hydrogen chloride wastes.

Sulfuric acid wastes are common to many industries, and recovery is an accepted practice. Falling-film evaporators are popular for use when the impurity level is low. When contaminants are organic in nature, submerged combustion is used, and $SO_2$ and $SO_3$ may be recovered from the effluent gases.

Of several million tons per year of waste HCl, perhaps 40% finds use in oil well activation, chemical and metal production, starch hydrolysis and cleaning applications.

Anhydrous HCl can be produced by stripping and condensation. HCl solutions contaminated with metals may be regenerated by ion exchange.

Recent interest centers on the electrolysis of hydrochloric acid (developed by de Nora[5] and Farbwerke Hoechst,[9]) catlytic Deacon-type oxidation (developed by Shell Development, M. W. Kellogg,[9] and Airco[9]) and metal chlorination followed by electrolytic or chemical oxidation.[9]

The direct chlorination of hydrocarbons by HCl to produce trichloro- and perchloroethylene is another development. $CCl_4$ is now made from carbon disulfide rather than from methane in order to avoid the disposal problem.

Sulfur and nitrogen oxides in gaseous effluents are a problem for the electric utility, sulfuric acid, fertilizer, metallurgical, and pulp industries. This last industry recovers $SO_2$ by wet scrubbing while sulfuric plants catalytically oxidize any $SO_2$ in the effluent to $SO_3$ and recover sulfuric acid by wet scrubbing.

Other proposed processes to recover $SO_2$ and $SO_3$ are:

The Simon-Carves-Cominco process, based on wet scrubbing with ammoniacal solution to produce ammonium sulfate and either sulfur or sulfur dioxide.

The soda ash-zinc oxide process, based on wet scrubbing with a soda ash solution that is regenerated with $ZnNO_3$ and lime--$SO_2$ is the product.

The manganese oxide process, based on wet scrubbing with a manganese dioxide solution to produce $SO_2$.

Wet oxidation, based on the oxidation of $SO_2$ to $SO_3$ using ozone in a manganese sulfate solution.

The adsorption processes, based on the use of activated char in water.

The recovering of nitrogen oxides in the tail gases from nitric acid plants is accomplished by catalytic conversion to $NO_2$ and subsequent absorption. A number of other chemicals are also recovered, including boric acid by chelation from brine wastes, sodium sulfate from cracking-catalyst production wastes by crystallization, argon from hydrogen plants by fractional distillation, and silica from ferrosilicon plants by air filtration.

The fluoride content of these liquors, present as hydrofluosilicic acid ($H_2SiF_6$), represents a problem and an opportunity. The fluoride evolved during wet acid phosphoric acid, superphosphate and triple super-phosphate production in this country is equivalent to the total U.S. production of HF--the source of fluorine compounds used in the production of aluminum, fluoro-carbons and other chemicals. The availability of high-grade fluorspar ore, the main source of HF, is limited, and these liquors represent an increasingly important source of fluorine.

The principal treated effluents of the petroleum industry are oil-water emulsions and gaseous effluents.[2]

Techniques, both proposed and in use, to recover the oil from emulsions include:

Filtration.
Gravity and multigravitation separations.
Flotation and foaming.
Capillary flow.
Sonic and ultrasonic energy input.
Electrical coalescence.

The recovering (from $H_2S$) is accomplished through partial oxidation:

Additional sulfur recoveries are made through the thermal degradation of acid sludges, producing by-product $SO_2$.[2]

While efforts are continuously being made to recover fines from coal mining, few have centered on the recovering of chemical and fuel values from two principal wastes--coal refuse, known as gob or culm, and acid mine-drainage effluents.

At least one process for the recovery of fuel and roadfill from coal refuse is being piloted by Pennsylvania State University and the U.S. Public Health Service,[13] and involves a heavy-media-cyclone separation of the coal portion from the refuse.

The pulp and paper industry has made major reductions in its industry-wide organic discharge load.

Economic means of recovering cooking chemicals from sulfite and NSSC mills have not been available and this had tended to slow the growth of these processes.

Acid calcium sulfite liquors are often evaporated and incinerated, thereby reducing effluent problems and producing steam as a byproduct.

Recovery schemes have been commercialized around a flow diagram that invovles evaporation followed by smelting to recover heat and chemicals.

Among the developed processes are:

The Institute process,[52] in which the green liquor is converted to a cooking liquor by contact with fresh sulfur dioxide.

The Mead process,[4] in which the solution is carbonated to remove the sulfur as $H_2S$.

The Sivola[62] process, similar to the Mead process except that the $H_2S$ is converted to $SO_2$ in a special burner.

The Stora Kopparberg[28] process, also similar to the Mead process except that the $H_2S$ is reacted with the $SO_2$ in the flue gases to produce sulfur for recycle.

The Western Precipitation (Bradley) process,[22] in which the green liquor is further evaporated until crystalline sodium carbonate is recovered and then redissolved to produce a sodium carbonate solution.

The Sulfox process, in which the smelt is oxidized to recover soda and sulfur.

The A. D. Little process,[61] in which the sodium sulfide and carbonate form a recovery furnace are melted in a glass-making furnace with silica. The $SO_2$, produced from the recovery and glass furnaces, is absorbed in a sodium sulfite and silica (which is separated by filtration).

Complete or partial oxidation processes are appealing because of their simplicity, but in many instances they do not recover the pulping chemicals.

The Pritchard-Fraxon[56] and Abiperm[51,64] processes are examples of ion-exchange recovery systems that can treat sodium-, magnesium-, calcium- or ammonium-based liquors.

Byproduct Chemical Recover: Lignins, and Lignin Derivatives--Lignin (that portion of the wood cell that surrounds or impregnates the cellulose and is acid insoluble and alkali soluble) is now recognized as an organic chemical precursor with a potential almost as vast as coal and petroleum. Lignins already find application as:

Components in finished paper products.

Lignosulfonates for oil well drilling-mud additives, road binders, animal-feed pelletizing agents, cement additives, industrial cleaners, chelating agents, leather tanning agents, adhesives, insecticides, and complexing agents for both treating boiler feed waters and supplying plant nutrient metals to soils.

The raw material for vanillin (1,100,000 lb./yr.), and for vanillin derivatives, which are used as food preservatives, drugs, sunburn oil additives, and polymers.

The raw material for the production of aliphatic sulfur compounds such as dimethyl sulfide and dimethyl sulfoxide (DMSO), which are used as ordorants, solvents, reaction intermediates, dispersants and plasticizers. DMSO has recently been shown ot have interesting medical properties.

The development of lignin as an organic raw material is in ints infancy, and further utilization of this largely wasted resource is to be expected in the future.

A number of other chemical byproducts are or can be recovered from pulp effluents.[48] Among those recovered commercially are: Sulfate turpentine, pine oil, tall oil, methanol, acetic and formic acids, glucose, levulinic acid, activated charcoal, synthesis gas, and various forms of cellulose.[6]

Fermentation, Distillery and Brewing industries often use wastes as feedstock. Wastes include:

Processing chemicals, especially solvents, that are usually recovered by distillation, solvent extraction or carbon adsorption.

Fermentation, distillery and brewing broths, which are evaporated, dried and either incinerated or used for animal feeds. Additional amounts of brewery wastes serve as feeds to pharmaceutical facilities and as additives to baby foods.

Among the chemicals recovered are d-lactone and l-lactone following calcium pantothenate production, vitamins and amino acids from fermentation wastes, bactracin and amino acids from distillers' solubles, tartaric acid from wine residues, nicotinic acid from vitamin wastes, glycerol from alcohol stillage, and potash from the incineration of fermentation wastes.

Sugar and Starch-- The tremendous quantities of waste produced by the sugar and starch industry has engendered large-scale efforts to obtain valuable byproducts. The principal use of bagasse is as a fuel to supply energy for the sugar mill.

Other commercial applications include use: In wallboard; as feed for paper mills; as filler in ligno-cellulosic materials, resins, plastics and laminates; in vanillin production; in furfural production; as cattle feed; a source of various lignin- and hemicellulose-based chemicals; a source of ethyl alcohol, glucose, acetic acid and xylose via fermentation; a source of yeast; a source of acetic acid methanol, coke and activated carbon by destructive distillation; an aggregate in light-weight concrete units; and a source of other organic chemicals.

The lime sludges from beet sugar mills may be used as ferilizers for low pH soils, but this use is not widespread. The present-day production of pearl starch from either wheat or corn would not be possible[55,94] without byproduct recovery. Among the most important byproducts of this industry are: gluten, which is the principal byproduct and is used in animal feeds; vital gluten from wheat starch, which is used in baking; corn steep liquor, produced in corn wet milling, which is sued as a cattle feed or nutrient in fermentation broths; germ oil, which is used in animal feeds; and zien, a protein used in fiber production.

Several industries including soap, leather, blue and gelatin have been based upon meat packing byproducts. Some other interesting waste recovery processes include:

Use of electrodialysis to remove salt from whey for infants' feeding formula products.

Use of citrus wastes as a fermentation medium.

Recovery of glycerin.

The recovery of chromates (by precipitation or ion exchange) from tanning wastes.

One of the most interesting waste products generated by the textile industry is wool grease. This product, recovered by solvent extraction, is processed into lanolin, cholesterol, other components used in greases and as rust proofing compounds, and used by the cosmetic, pharmaceutical, adhesives, printing ink, soap, petroleum, cordage, and leather tanning industries.

It has been argued that starch and glucose might be recovered by either evaporation or membrane processes in sizing plants, suint (a deposit in wool used for detergent manufacture) might be recovered by solvent extraction from wool wastes; while soap might be obtained from washing operations by membrane or foaming processes.

Sulfate pickle liquor, arising in large volumes during the removal of oxide scale from steel products by dilute sulfuric acid, presents a severe disposal problem.

Copperas (useful as a coagulant) can be recovered by the addition of scrap iron or lime to the concentrated acid.

Dialysis, ion exchange[36] and acid retardation have been suggested as means of separating acids from their metallic salts, and dialysis has found particular application in the recovery of phosphoric acid "bright dip" solution, and of nickel and copper sulfates from plating baths.

A solvent extraction process involving complexing and extracting the iron with a mixture of tributyl phosphate kerosene has been developed.[7] This produces calcium sulfate, magnetic iron oxide and fresh pickle liquor.

Scrubbing of coke-oven ammonia or gas with pickle liquor produces iron oxide and ammonium sulfate. Conversion of iron values from sulfates to oxides is clearly advantageous, since the iron oxides have large markets. Other applications of pickle liquor include its use in:

Neutralized sludge as a construction material.
Preparing sodium natrojarosite, a coagulant.
Making sodium sulfate.
Preparing ferric phosphate.
Leaching manganese ores to produce a manganese concentrate.

Many platers have found that treatment costs are more than paid for by the recovery of plating metals, cyanides and chromates. Ion exchange, which is commonly applied because the chemical nature and concentration of the wastes are ideally suitable, produces chemical recoveries typified by those in Table VIII.

Cyanides have been recovered by complexing (the complex may be used as a blue pigment) and by distillation of hydrogen cyanide. Metals have been recovered by chemical precipitation, dialysis and electrodialysis.

Recovery of chemicals from plating wastes by ion exchange—Table VIII

| Waste | Chemical Recovery | Exchange Type | Regenerant | Reference |
|---|---|---|---|---|
| Brass-pickling liquor | Copper, zinc, chromium metals precipitated with soda ash and recovered by chemical means | Strongly acidic cation, hydrogen or sodium | $H_2SO_4$(66°Bé) | 72 |
| Anodizing, chromating, chrome-plating, bright-dipping and copper-stripping wastes | Chromates for recycle | Strongly basic anion | Caustic | 37,110 |
| Cyanide leach liquors | Gold | Strongly acidic cation | $H_2SO_4$ | 91 |
| Mine waters | Zinc | Strongly acidic cation | $H_2SO_4$ | 91 |
| Cooling tower effluents | Chromates | Strongly basic anion; hydroxide form | Caustic | 77 |
| Plating wastes | Cyanides and copper | Strongly basic anion; strongly acid cation | Caustic-HCl | 107 |
| Copper, silver and zinc cyanide plating wastes | Metal and cyanides | Strongly basic anion; strongly acid cation | Caustic-HCl | [illegible] |

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**Descriptors (continued from page 1)**

solids separations
gravitational force
multi-gravitational force
interference
scrubbing
electrostatic precipitation
ultrasonics
cryogenic scrubbing
petroleum effluents
inorganic acids
hydrochloric acid
oxychlorination processes
distillation
chlorinated hydrocarbons
olefins
acetaldehyde
solvents
crystallization
xylene
carbon
disulfide
carbon tetrachloride
extraction
isobutylene
naphthalenes
paraffins
phenol
organic dyes
amino acids
amines
alkaloids
organic acids
caustic
ammonium sulfate,
coal tars
oils
coal gas
phenolic-containing liquors
phenol
sulfuric acid wastes
hydrochloric acid
hydrogen chloride wastes
waste HCl
anhydrous HCl

wet oxidation
nitrogen oxides
catalytic conversion
boric acid
sodium sulfate
argon
silica
fluoride
oil-water emulsions
capillary flow
electrical coalescence
acid sludges
coal refuse
gob
culm
acid mine-drainage effluents
refuse
acid calcium sulfite liquors
smelting
the Institute process
the Mead process
the Sivola process
the Stora Kopparberg process
the Western Precipitation (Bradley) process
the Sulfox process
the A. D. Little process
pulping chemicals
the Pritchard-Fraxon and Abiperm processes
lignins
lignin derivatives
lignosulfonates
insecticides
stillage
brewery wastes
fermentation wastes
wine residues,
vitamin wastes
alcohol stillage
bagasse
lime sludges
citrus wastes
tanning wastes
wool grease
sulfate pickle liquor

neutralized sludge
cyanides

Disease/Solid Waste
Abstracts

No. DSW-215

Author

Gordon M. Fair and John C Geyer

Title

Elements of Water Supply and Waste-Water Disposal

Reference

N.Y., John Wiley & Sons, inc., 1965

Doc. No. Contract No. Date issued

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Abstract

The great volumes of sludge that must be disposed of are serious economic problem, especially in sewage treatment. The presence of substantial amounts of organic matter that can serve as food for saprophytic bacteria and other scavenging organisms renders some sludges, including all but exceptional sewage sludges, putrescible. Exceptional sewage sludges are those derived from waste waters containing toxic substances such as copper.

Since bacteria and other organisms are concentrated in sludge and some of them are pathogenic, the hygenic significance of sludge is often as great as its esthetic and economic significance. In the treatment of municipal sewage, thousands of gallons of putrescible and potentially dangerous sludge are removed from each million gallons of sewage treated.

The concentration of chemical fertilizer-ingredients is expressed as a percentage of the dry weight of the sludge. The nitrogen content of sludges produced by the treatment of domestic sewage varies in fresh sludges from 0.8 to 5% for plain-sedimentation solids (and proportionately less in sludges including chemical precipitating agents) to 3 to 10% for activated sludges. Trickling-filter humus contains 1.5 to 5% nitrogen, decreasing with the length of storage of the sludge in the filter. Digestion reduces the nitrogen content of sludge by 40 to 50% The phosphoric acid content of most sewage sludges is small (1 to 3%), and that of potash even smaller (0.1 to 0.3%). For purposes of comparison, animal manures contain 1 to 4% of nitrogen and about the same percentage of phosphoric acid and potash. Animal tankage, blood, and fish scraps include 5 to 13% nitrogen and 0.5 to 14% phosphoric acid. Cottonseed meal and castor pomace are about as rich in nitrogen and phosphoric acid as animal tankage, blood, and fish scraps. In addition they contain 1 to 2% potash.

Nitrogen and humus content are ordinarily the determining factors in the utilization of sewage sludges. These sludges are applied directly, or they are used as a fertilizer base (other needed elements being added) or as commercial fertilizer fillers. Not all the nitrogen present in sewage sludges is in forms

Descriptors (See page 10)

Abstract (continued)

that are directly available to plants. Because of this, determinations normally include those for nitrate, ammonia, and organic nitrogen. Nitrate is directly available, ammonia after conversion in the soil to nitrate, and organic nitrogen after breakdown and oxidation in the soil. The true usefulness of fertilizers in meeting the needs of different crops can be fully determined only by field tests. The presence of grease in sludge is not agriculturally desirable.

The utilization of sewage sludges is circumscribed by the hygienic hazards involved Pathogenic bacteria, viruses, protozoa (cysts), and worms (eggs) can survive sewage treatment and be included in the sludge. There, they will persist for long times and cannot be fully destroyed by digestion or air-drying. Although the numbers of surviving organisms decrease appreciably in the normal course of events, only heat-dried sludge can be considered fully safe

TABLE 17-2. Proportion of Solids in Domestic Sewage Sludges

| Treatment Process | Condition of Sludge | % Solids |
|---|---|---|
| 1. Plain sedimentation | a. Fresh-depending upon method of sludge removal | 2.5-5 |
| | b. Digested-wet | 10-15 |
| 2. Chemical precipitation | a. Fresh-increasing in moisture with amount of chemical used | 2-5 |
| | b. Digested-wet | 10 |
| 3. Trickling filtration | a. Fresh humus alone-depending upon length of storage in filter | 5-10 |
| | b. Fresh humus mixed with 1a | 3-6 |
| | c. Digested 3b-wet | 10 |
| 4. Activation | a. Fresh*-depending on method of sludge withdrawal | 0.5-2 |
| | b. Digested*-alone | 2-3 |
| | c. Fresh-settled with 1a | 4-5 |
| | d. Digested-with 1a | 6-8 |

*If primary sedimentation is curtailed, suitable adjustments must be made.

The sludge cake is usually from 1/16 in. to 1/4 in. thick. Its solids content is as high as 32% for plain-sedimentation sludge (raw or digested) and as low as 20% for raw, activated sludge. Digested, activated sludge may be dewatered to about 25% solids content.

Sewage sludge is heat-dried to less than 10% moisture when it is to be sold as a commercial fertilizer. Heat-drying may also precede the use of sludge as a fuel for sludge-drying or other plant purposes. The dried sludge is then burnt in a furnace. Drying is promoted by adding a dufficient amount of previously dired sludge to the incoming cake to reduce the moisture of the mixture

## Abstract (continued)

to about 50%.

Bed-dried, digested sludge contains about 50% solids. Its volume is about half that of the wet sludge The sludge is removed by hand-forking or by mechanical, sludge loaders or strippers.

In air-drying, moisture is lost to the atmosphere by evaporation and to the bed by percolation.

Wet, sewage sludge may be pumped onto land and plowed under. Digested sludge is more suitable for this purpose than raw sludge. In favorable circumstances, sewage sludges may be discharged into water. Seacoast communities may transport either wet or partially dewatered fresh or digested sludge to dumping grounds at sea. Specially designed sludge tankers and scows or barges are used for this purpose. Wet, digested sludge may be discharged into large streams (more particularly in times of flood runoff) without creating a nuisance, or it may be pumped to deep-lying and hydraulically active portions of tidal estuaries. Sludge lagoons may be used both for the digestion of raw sludge and for the storage and consolidation of digested sludge. The odors produced by raw sludge must be taken into cognizance in this connection. Low-lying land can be filled by lagooning or by the dumping of filter-cake or air-dried sludge. Inclusion of partially dewatered sludge or sludge cake in sanitary land fills is a possibility. Air-dried sludge as well as filter cake may be hauled away by farmers to serve as a soil builder. Disintegration of the sludge for this purpose is of some value. As described in Section 17-8, dried sludge is commonly used as a fertilizer or fertilizer base, or it is incinerated. The ash from incinerators can be disposed of as fill, or it can be dumped at sea.

Wastes Containing Mineral Impurities - Examples of waste waters that contain large or detrimental amounts of mineral impurities are steel-pickling liquors, copper-bearing wastes, electroplating wastes, gas- and coke-plant wastes, oil-field brines and petroleum-refinery wastes, and mining wastes.

a. Steel-pickling liquors. Steel and iron are pickled in acid (normally sulfuric acid) prior to cold working, galvanizing, plating, or similar operations. The acid concentration of the pickling bath declines from an initial value of 5 to 15% to one of 1.5 to 5% while its concentration of ferrous iron rises as high as 4 to 30% Neutralization of the spent pickling liquor, which contains other impurities as well, is costly and leaves large volumes of sludge Processes for the recovery of ferrous sulfate or acid include: (1) evaporation of water to crystallize impurities; (2) crystallization of ferrous sulfate by cooling or by the addition of organic solvents; (3) use of scrap iron to neutralize residual acidity followed by evaporation to recover copperas; (4) recovery of sulfur and iron oxides by roasting recovered copperas; (5) electrolytic recovery of iron; and (6) dewatering and processing of the sludge after neutralixation with lime to produce building and insulating materials. Diluteness of the waste, presence of extraneous impurities, and a limited market for ferrous sulfate impose formidable barriers to profitable recoveries.

b. Copper-bearing wastes. Pickling and washing of copper and its alloys after hot working and annealing leaves copper in the waste liquors. Very small amounts of copper (less than 1 mg/l) will interfere with the life of streams and biological sewage-treatment works. The relatively high cost of copper makes its recovery more profitable than that of ferrous sulfate or iron. Available methods are: (1) electrolytic treatment of the pickling liquor to recover copper and regenerate the acid; (2) crystallization of copper sulfate, which may require neutralization of spent acid with copper oxide scale; (3) lime neutralization followed by sedimentation; and (4) passage through iron turnings or other scrap iron or steel, iron being dissolved and an equivalent amount of copper being precipitated as recoverable metal

Abstract (continued)

c. Wastes containing chromates and cyanides. Chromates, or hexavalent chromium ($CrO_4$= and $CR_2O_7$), and sodium cyanide (NaCN) are widely used in electroplating and other electrolytic operations The concentration and composition of the toxic waste waters vary widely. About 1 mg/l of chromate (as Cr) or cyanide (as CN) appears to be the permissible limit of these substances in sewage that is to be treated biologically. Reduction of spillage, draining of processed pieces, prewashing, use of wash waters to make up new solutions, and recovery of spent baths are measures of control. Chromates may be removed by precipitation with a barium salt and an alkali or with ferrous sulfate. They may be reduced to the relatively non-toxic trivalent chromic or chromite forms ($Cr^{+++}$ or $CrO_2$-) by passage over scrap iron. Cyanides can be volatilized by acidification and aeration provided that safeguards are taken against the poisonous effects of the hydrogen cyanide (HCN) that is released. Cyanides can be precipitated with ferrous sulfate and lime. Chlorination in alkaline solution will convert them to less toxic cyanates such as NaOCN. Further chlorination results in the decomposition of cyanates to carbon dioxide and nitrogen.

d. Gas- and coke-plant wastes. Vapor condensates from manufactured gas and from the quenching of coke throw considerable quantities of ammonia, phenols, cresols, sulfides, cyanides, and thiocyanates into the waste waters. They have a high oxygen demand, are toxic, and impart to receinving waters tastes and odors that are difficult to remove Phenol appears to be the principal offender (Section 18-21). Acclimated trickling filters can oxidize phenolic waters that contain several hundred milligrams per liter of phenol. Activated sludge is less tolerant, but 50 mg/l will not cause injury in favorable circumstances.

Recovery of ammonia from gas- and coke-plant wastes is common. The spent liquors, which contain lime used to free the ammonia as well as most of the remaining contaminants, may then be evaporated or subjected to phenol recovery: (1) by solvents, such as benzol, benzene, pyridine, and tricresyl phosphate; (2) by adsorption on activated carbon; or (3) by distillation. Otherwise the wastes may be treated on trickling filters, either with domestic sewage or after dillution with treated sewage effluents or other waters.

e. Oil-field brines and petroleum-refinery wastes. Oil-field brines, which average about 3.3 times the amount of oil pumped, contain as much as 32.5% total solids and 20% chlorides. Their solids load may indeed be ten times that of normal sea water. Although they are usually less heavily mineralized than this, most oil-field brines are sufficiently saline to destroy fresh-water life unless they are highly diluted Since heavy concentrations of dissolved solids can be removed satisfactorily only by distillation at great expense, the economical disposal of brines remains a challenge. Methods of disposal include: (1) storage in ponds for evaporation and seepage and (2) recharge of deep saline strata by pumping, often as a means of increasing the yield of oil. Seepage from lagoons may render ground waters salty and clog water-bearing formations The oil in brines and refinery wastes may be removed by flotation and skimming. Gas flotation increases the yield. Hydrogen sulfide, mercaptans, phenols, and similar substances may have to be removed when receiving waters serve as sources of water supply.

## Abstract (continued)

f. Mining wastes. Mining wastes include (1) the mineralized and acid water pumped or drained from mines and (2) the waste waters from the washing and processing of coal or ore. Acid coal-mine drainage and coal-washing wastes are a widespread source of trouble. The acidity and iron content of coal-mine drainage is due to the oxidation of iron pyrites ($FeS$) to ferrous sulfate and sulfuric acid. No satisfactory method for reducing the acid load has as yet been found Included in methods tried are: (1) the flooding of abandoned mines; (2) the sealing of mine entrances with water traps to exclude the oxygen needed to form acids; (3) the reduction of seepage into mines by diversion of surface streams or by other drainage works; and (4) the nautralization of the drainage waters by the addition of lime or by their passage through beds of limestone. The application of inactivating coatings to exposed surfaces is in the experimental stage.

The suspended matter in coal-washing wastes can be removed by sedimentation with or without coagulation. An alkalized solution of potato starch is a good coagulant.

Wastes Containing Organic Impurities - The most important organic wastes are produced by milk-processing plants, meat-packing establishments, breweries and distilleries, and canneries

a. Milk-processing wastes. Milk-plant wastes contain washings (1) from cans, pasteurizers, coolers, churns, and other equipment, and (2) from the plant floor. Their BOD is high (up to several thousand milligrams per liter), and their decomposition is rapid. Reduction of spillage, fuller drainage of cans and equipment, and recovery of solids from first rinsings will reduce losses. Treatment methods include: (1) chemical precipitation with lime and iron in dosages up to 500 mg/l; (2) activated-sludge treatment, possibly aided by small amounts of iron coagulant; and (3) trickling filtration Treatment on trickling filters is common. Dosing rates range from 0.5 to 1.5 mgad without recirculation of effluent and from 2 to 6 mgad (net) with recirculation. The liquid going to the filter should have a BOD of less than 400 mg/l. If the effluent BOD must be low, the BOD of the applied waters must be reduced. Double filtration with alternation of the leading filter has been quite successful. It provides relief for the leading filter after it has been dosed for a time with concentrated wastes.

b. Meat-packing wastes. Packing-plant and abattoir wastes contain blood, grease, excreta, paunch contents, liquors from rendering and other processing operations, and floor washings. The larger the plant, the more economical does recovery become, and the smaller is the resulting weight of solids lost per animal slaughtered. Meat-packing wastes are treated in ways common to the treatment of domestic sewage. Consideration must be given to the strength of the applied wastes. This may be high.

c. Brewery and distillery wastes. The principal waste material of breweries and distilleries is spend grain. The food values of this residue are high and can be recovered profitably as a feed for hogs and cattle either as liquid slop or as dry feed. Alternate methods of disposal are: (1) use as fertilizer; (2) re-use of part of the distillery slop to make up new mash; and (3) anaerobic fermentation. Wastes that contain less suspended but more dissolved organic matter (for example, steepings and washings) may possess such high BOD values that they must be evaporated or treated biologically. Suspended

Abstract (continued)

solids are generally removed by sedimentation prior to biological treatment.

d. Vegetable- and fruit-processing wastes The characteristics of vegetable- and fruit-processing wastes vary within wide limits with the raw materials and the process. BOD values range up to 60,000 mg/l, and the wastes may be strongly acid or alkaline. Treatment and disposal are peculiarly difficult because of the seasonal nature of the industry and because of the shifting from one vegetable or fruit to another as the season advances. Screening and lagooning or irrigation are used most often. Screenings are buried, burned, spread on land, or used for feed Lagoons, less than 5 ft deep, should hold 125% of the seasonal volume of waste waters. About 25% of these waters is stored over the winter in order to dilute and seed the next year's batch. Water is discharged from the lagoons by evaporation and seepage and by withdrawal into receiving waters during spring freshets. Nuisances due to the depletion of oxygen can be combated by the addition, to waste waters of average strength, of sodium nitrate at a rate of 200 lb or less for each pack of 1,000 No. 2 cases. Disposal by irrigation requires suitable land areas. Waste water to depths as high as 600 in. per year has been sprayed onto sandy areas covered with underbrush and forest litter.

Wastes Containing Both Organic and Mineral Impurities - Examples of such wastes are those of the textile industry, laundries, tanneries, and paper mills.

a. Textile wastes. These wastes are derived from deterging and fiber preparation, and from dyeing, printing, and finishing processes. The variety of fibers (wool, cotton, silk, linen, synthetics, etc.) is great, and the kinds and colors of goods produced are numerous. As a result, textile waste waters vary in composition and strength more than other indusitral waste-waters. Only a few examples of their disposal are given below.

The scouring of wool produces a water-carried waste that contains dirt, manure, burrs, spent soap, and large amounts of wool grease. Grease can be recovered by lowering the pH of the settled waste with sulfuric acid to a value of 3 or 4 (acid cracking) to break the soap emulsion In the acid tanks, most of the fat settles as a sludge, the remainder rises to the surface. Chlorination, aeration, coagulation, pressing, and centrifuging also find use in the recovery process. Extraction by solvents prior to scouring yields wool grease of high quality (lanolin).

Cotton kiering is the boiling of woven goods in water containing 0.5 to 3.0% of caustic and soda Gums, pectins, vegetable impurities, and sizing are separated from the fiber. The resulting waste water is highly alkaline and has a BOD of thousands of milligrams per liter. Neutralization with sulfuric acid or carbon dioxide must precede biological treatment on filters. Alkaline bleaching wastes will neutralize or decolorize acid or colored wastes. Bleaching wastes may also be combined with kier liquors for disposal Mercerizing wastes are sufficiently concentrated to justify recovery of the caustic by dialysis or evaporation.

Dye wastes are deeply colored. Highly acidity or alkalinity, or the dye itself, may render them destructive to aquatic life. They can be treated chemically (by coagulation, bleaching, or absorption) or biologically (on trickling filters or in activated-sludge units). Decolorization is rarely complete. Waste waters from dyeing, printing, and finishing operations are so variable in volume and composition that experimentation should precede the selection of a plan of treatment.

Abstract (continued)

b. Laundry wastes. Laundry wastes contain (1) spent soaps, synthetic detergents, bleaches, and (2) dirt and grease. They respond to coagulation with alum or ferric coagulants in combination with calcium chloride or sulfuric acid. Dosages range from 1 to 5 lb per 1,000 gal.

c. Tannery wastes. Roughly half of the BOD (several thousand mg/l) of tannery wastes is concentrated in liquors from the preliminary processes of soaking, liming, dehairing, and fleshing the hides ("beamhouse wastes"(3)), and the other half from the tanning and finishing process. Preliminary processing removes highly putrescible materials; final processing introduces toxic chemicals, such as sulfides and chromates, as well Variations in the characteristics of the wastes within a given tannery and between tanneries are high. Treatment methods include screening, flocculation, sedimentation, and biological filtration. Success of treatment depends on adequate blending and neutralization of the various waste waters.

d. Paper-mill wastes. Production of wood pulp by the sulfite, soda, or sulfate (kraft) processes is common. Wastes from sulfite mills do the most damage to receiving waters and are the most difficult to treat. Ponding, digestion, and evaporation have been tried in addition to patented processes that recover sulfur dioxide or sulfites. Caustic soda is usually recovered from soda- and sulfate-pulping liquors. "Black liquor" containing wastes cooked from the wood fibers is evaporated, and the solids are burned to produce "black ash." This material is added to fresh soda ash to make up "green liquor" which, in turn, is causticized with quicklime, settled, and filtered to produce white liquor," which is used in the pulping process. Activated carbon is a salable by-product. It is prepared from residues of soda recovery.

Waste waters from the reclamation of old paper carry ink and clay filler removed from the paper, as well as spent caustic and soda ash from the processing baths. Recovery of chemicals from these waste waters has not been found profitable.

The wastes from beaters, refiners, and paper-making machines ("white waters") contain about 5% fiber and 45% clay. These are recovered by screening and sedimentation, or the water is recirculated after it has been chlorinated to prevent the development of slime growths.

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(3) From the process of working or dressing hides over a beam or in a beaming machine.

Abstract (continued)

### TABLE 20-1

### Quality Tolerances for Industrial Process Waters

All values are expressed in parts per million.

| Industry or Use | Turbidity | Color | Hardness as CaCO$_3$ | Iron as Fe | Manganese as Mn | Total Solids | Alkalinity as CaCO$_3$ | Odor Taste | Hydrogen Sulfide | Other Requirements |
|---|---|---|---|---|---|---|---|---|---|---|
| Air conditioning | .. | .. | ... | 0.5 † | 0.5 | ... | ... | Low | 1 | No corrosiveness or slime formation |
| Baking | 10 | 10 | ... | 0.2 † | 0.2 | ... | ... | Low | 0.2 | Potable water |
| Brewing, light beer | 10 | .. | ... | 0.1 † | 0.1 | 500 | 75 | Low | 0.2 | Potable, NaCl less than 275 ppm, pH 6.5–7.0 |
| dark beer | 10 | .. | ... | 0.1 † | 0.1 | 1,000 | 150 | Low | 0.2 | Potable, NaCl less than 275 ppm, pH 7.0 or more |
| Canning, legumes | 10 | .. | 25–75 | 0.2 † | 0.2 | ... | ... | Low | 1 | Potable |
| general | 10 | .. | ... | 0.2 † | 0.2 | ... | ... | Low | 1 | Potable |
| Carbonated beverages | 2 | 10 | 250 | 0.2(0.3) † | 0.2 | 850 | 50–100 | Low | 0.2 | Potable, organic color plus oxygen consumed less than 10 ppm |
| Confectionery | .. | .. | ... | 0.2 † | 0.2 | 100 | ... | Low | 0.2 | Potable |
| Cotton bandage | 5 | 5 | ... | 0.2 † | 0.2 | ... | ... | Low | ... | |
| Food, general | 10 | .. | ... | 0.2 † | 0.2 | ... | ... | Low | ... | Potable |
| Ice | 5 | 5 | ... | 0.2 † | 0.2 | ... | ... | Low | ... | Potable, SiO$_2$ less than 10 ppm |
| Laundering | .. | .. | 50 | 0.2 † | 0.2 | ... | ... | .... | ... | |
| Paper and pulp, ground wood | 50 | 20 | 180 | 1.0 † | 0.5 | ... | ... | .... | ... | No grit or corrosiveness |
| kraft pulp | 25 | 15 | 100 | 0.2 † | 0.1 | 300 | ... | .... | ... | |
| soda and sulfite | 15 | 10 | 100 | 0.1 † | 0.05 | 200 | ... | .... | ... | |
| high-grade light papers | 5 | 5 | 50 | 0.1 † | 0.05 | 200 | ... | .... | ... | No slime formation |
| Plastics, clear, uncolored | 2 | 2 | ... | 0.02 † | 0.02 | 200 | ... | .... | ... | |
| Rayon (Viscose), pulp production | 5 | 5 | 8 | 0.05 † | 0.03 | 100 | Total 50 hydroxide 8 | .... | ... | Al$_2$O$_3$ less than 8 ppm, SiO$_2$ less than 25 ppm Cu less than 5 ppm, |
| manufacture | 0.3 | .. | 55 | 0.0 | 0.0 | ... | ... | .... | ... | pH 7.8 to 8.3 |
| Tanning | 20 | 10–100 | 50–135 | 0.2 † | 0.2 | ... | Total 135, hydroxide 8 | .... | ... | |
| Textiles, general | 5 | 20 | ... | 0.25 | 0.25 | ... | ... | .... | ... | |
| dyeing | 5 | 5–20 | ... | 0.25 † | 0.25 | 200 | ... | .... | ... | Constant composition, residual alumina less than 0.5 ppm |
| Wool scouring | .. | 70 | ... | 1.0 † | 1.0 | ... | ... | Low | ... | |

* Progress Report, Committee on Quality Tolerances of Water for Industrial Uses, *J. New Eng. Water Works Assoc.*, *54*, 271 (1940).
† Limit given applies to both iron alone and the sum of iron and manganese.

**Abstract (continued)**

### TABLE 19-2

### Classification of Receiving Waters According to Use and Requisite Quality

| Use (1) | Standards of Quality at Low-Water Stage (2)* | Required Treatment of Sewage before Discharge: Normal (3) | Required Treatment of Sewage before Discharge: Emergency (4) | Required Treatment of Water before Use Shown in Column (1) (5) |
|---|---|---|---|---|
| Industrial uses not needing a high-quality water; irrigation of crops not subject to contamination when intended for human consumption; and receipt of wastes without the creation of nuisance | Absence of nuisance—odors, slick, and unsightly suspended or floating matters; dissolved oxygen present at outfall | Sedimentation except when receiving waters are large in volume | Chlorination for removal of hydrogen sulfide; addition of nitrate to supply oxygen | Sometimes none; chlorination where needed |
| Fishing; recreational boating; raising of seed oysters; and industrial use after treatment | Absence of slick, odors, and visible floating and suspended solids<br>DO $\geq$ 3 mg/l and preferably $\geq$ 5 mg/l; $CO_2 <$ 40 mg/l and preferably $<$20 mg/l | Sedimentation, chemical precipitation, or biological treatment depending upon degree of dilution | Aeration; addition of diluting waters | Withdrawal of water not implied |
| Bathing, recreation, and shellfish culture | Clear; no visible sewage matter; a coliform IN less than 100 to 1,000 per 100 ml depending on length of bathing season; DO near saturation | Sedimentation, chemical precipitation, or biological treatment, depending upon degree of dilution; chlorination of effluent | Heavy chlorination | Withdrawal of water not implied |
| Drinking water and related uses | Chemical standards for substances not removable by common water-treatment methods; clear; DO near saturation; coliform MPN of 50/100 ml when chlorination is the only treatment; up to 20,000/100 ml when treatment is complete | Sedimentation, chemical precipitation or biological treatment depending upon degree of dilution; chlorination of effluent | Heavy chlorination | Chlorination when coliform MPN is less than 50/100 ml; pre- and post-chlorination, coagulation, sedimentation, and filtration when coliform MPN is up to 20,000/100 ml |

Descriptors

sludge
organic matter
saprophytic bacteria
trickling filter
animal manures
nitrogen
pathogenic bacteria
cysts
heat-dried sludge
dewatering solids
heat-drying
sludge tankers
sanitary land fills
dumped
electroplating wastes
gas- and coke-plate wastes
oil-field brines
petroleum-refinery wastes
mining wastes
toxic waste waters
saline
disposal
acid coal-mine drainage
milk processing wastes
grease
liquors
brewery and distillery wastes
vegetable-and fruit-processing wastes
spent soap
mercerizing wastes
dry wastes
bleaches
toxic chemicals
"black liquor"
toxic
hygienic
pathogenic
phosphoric acid
fish scraps
grease
viruses
worms (eggs)
filtration
sludge cake
evaporation
tidal estuaries
filter cake
mineral impurities
neutralization
residual acidity
pickling
volatilized
chlorination
phenols
sulfides
storage
acid water
meat-packing wastes
excreta
spent grain
suspended solids
alkaline
dirt
wool grease
caustic
laundry wastes
tannery wastes
sulfides
"black ash"
sewage
fertilizer
solids
potash
humus
oxidation
protoza
digestion
vacuum filters
activated sludge
percloration
sludge lagoons
incinerators
copper-bearing wastes
crystallization
electrolytic recovery
cyanides
acidification
ammonia
cresols
thiocyanates
re-charge
coal-washing wastes
blood
paunch contents
anaerobic fermentation
acid
textile wastes
burrs
alkaline bleaching wastes
dialysis
synthetic detergents
"beamhouse wastes"
chromates
paper-mill wastes

Disease/Solid Waste
Abstracts

No. DSW- 216

Author Subcommittee on Sludge Disposal
Committee on Sewerage and Sewage Treatment

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Progress Report

Reference Journal of the Sanitary Engineering Division; Proceedings of the American Society of Civil Engineers

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| n SA2 pgs. 13-51 | | March 1962 |

Abstract

Sludge disposal is probably the most controversial phase of sewage treatment today. Morgan and Thomson say the enigma of sewage treatment is the disposal of ever-accumulating sludge (1).[a] Bloodgood says the problem of sludge disposal is as great or greater than that of purifying the sewage (2). Hampton says that the disposal of solids removed from sewage presents an increasingly difficult problem to cities of all sizes due to high land values and increasing labor costs (3).

Many laymen think that sewage sludge can be sold as fertilizer for a net profit, but when capital, operating, and maintenance costs are totalled, there is always a net cost. Greater emphasis has been placed on its utilization as a soil conditioner and plant food. Mechanical methods are being used more to offset rising labor costs.

Final sludge disposal methods include: Use as fertilizer or soil conditioner; land fill and lagooning; burning to ash, and dilution in large bodies of water. Numerous methods for moving sewage sludge to final disposal are available, including: Concentration or thickening; digestion; elutriation; filtration; centrifuging; screening; drying on sand beds or in lagoons; and drying by heat. Other supplemental steps include: Sludge pumping; gas utilization; recovery of certain by-products; and processing of dried sludge for sale.

In Seattle's new $164 million sewage plan, it is proposed to discharge digested primary sludge through a 4,000-ft outfall into a 400-ft depth of water in Puget Sound. The new 7-mile sludge line for pumping digested sludge from the Los Angeles Hyperion Plant out into the Pacific Ocean has been the source of much discussion. Discharge depth was set at 300 ft to prevent sludge from rising to the surface.

Wirts of Cleveland, Ohio, has a novel idea for pumping digested sludge from the Cleveland area approximately 100 miles to waste coal strip mine areas in southeastern Ohio. His estimated service charge for pumping would be 10 to 15 cents per ton mile.

Descriptors

sludge disposal
solids
fertilizer
soil conditioner
plant food
land fill
lagooning
burning to ash
dilution
concentration
thickening
digestion

elutriation
filtration
centrifuging
screening
drying
sludge pumping
gas utilization
by-products
digested sludge
sedimentation tanks
sand beds
volatile solids

fluoride
grease
fats
lipids
methane
scum
recirculation
snail
stilling basin
digester

gas recirculation
accelerated sludge digestion
chemical conditioning
elutriation
anaerobic bacterial fermentation
dilution
alkalinity
vacuum filtration
coliform
disease
(see page 9

Sludge thickening is a basic step in the preparation of sewage sludge for final disposal. It begins in the sedimentation tanks and continues to the point at which water concentration is reduced to the desired minimum.

Sand beds continue to serve a useful purpose in sludge disposal. Sand bed drying is practically limited to digested sludge in this country. Large areas are required for beds, and labor costs are high. Because mechanical and heat-drying equipment is becomming cheaper and more easily operable, sand beds are being limited more to small and medium-sized towns. Beatty goes so far as to say that the trend is toward elimination of the open sludge drying beds because of original cost and cost of removing sludge and replacing sand.

Sludge may be stored permanently in lagoons, or it may be removed after sufficient dewatering for fertilizer or soil conditioner. Large, cheap land areas are required to justify such methods over other sludge disposal methods. Beatty says that at the present time, it appears that the most economical method of sludge disposal, from the standpoint of operation costs, is the use of deep sludge--disposal lagoons from which there is no intention of ever removing the sludge (45).

Digested, filtered sludge is satisfactory for land fill, the only costs being for hauling. Cost studies showed it would be more feasible to barge 10% solids sludge 11 miles into the ocean from the mouth of Delaware Bay at a cost of $8.78 per ton dry solids than to lagoon it.

Digesters were operated at various temperatures from 30°C to 65°C for the study. Little difference in digester efficiency, based on volatile solids reduction, gas production, and physical characteristics was noted in those units operated in the 35°C to 60°C range.

Warner N. Grune and Robert Q. Sload (66) report no detrimental effects were observed in a laboratory study in which 5 ppm sodium fluoride as fluoride were added to the sludge. The concentration was ten times that expected to be encountered in sludges as a result of fluoride being added to water supplies.

H. Heukelekian and Peter Mueller (69) report findings of experimental work on the transformation of fats during sludge digestion. This is of interest because of the relatively high grease concentration in raw sewage sludge. They found the destruction of fats or lipids oocurs best during periods of maximum methane production, and it is facilitated by thorough mixing in the digester.

A description of the operating procedure used at the Portsmouth, Va., sewage treatment plant, for adding lime to the digester to cure a falling pH, has been presented (73).

Control of scum in digesters is a serious problem common to many sewage plants. Methods of dispersing scum that have been tried include: Recirculation; breaking the scum up with water; and the use of alum. Various chemicals have been used for scum control, but more work needs to be done regarding their use for this purpose. Snail collection in the scum blanket resulted in a 50% reduction in the primary digester capacity at the Turkey Creek Plant, Joplin, Mo. A stilling basin and a basket screen have been designed to remove the snails before they enter the digester.

The use of cellular glass to insulate the walls of a digester at Steubenville, Ohio, has been reported (93). The use of cellular glass resulted in a reduction in digester size and an increase in the operating efficiency of the digester.

Experiments conducted at the Maple Cross Works of the Colne Valley Sewerage Board in England have indicated gas recirculation will control digester scum formation and it gives a better digested sludge (101). James H. Blodgett (102) summarizes the operating results of the "Catalytic Reduction Process" of accelerated sludge digestion at Columbus, Ohio. The digester was operated for more than 2 yr with volatile solids reductions comparable to conventional digestion, although the loading was double and the detention time less than one-half that of conventional digestion. A. Prescott Polwell (104) presents a summary of recent literature on high-rate digestion. He feels the chief essentials to successful high-rate digestion are continuous mixing and sludge thickening. Sterling B. Brisbin (109) reports on the results obtained from a full-scale sludge thickener operation at the Middleborough, Mass., sewage treatment plant. A reduction in sludge volume from 3,900 gal of sludge per million gal of raw sewage to 1,215 gal per million gal of raw sewage was obtained following thickening. John H. Jenks (113) reports sludges containing 30% solids have been obtained by centrifuging without chemical conditioning.

Elutriation continues to show primise as a means of sludge thickening. A discussion of elutriation theory and practice also points out the increasing interest in sludge elutriation as a method of sludge thickening (114). Anton E. Sparr (115) reports the results of a limited plant scale study, at the Bay Park Sewage Treatment Plant, of sludge elutriation. The study led to the development of a hypothetical relationship among the quality of the elutriation tank effluent and dry solids loading, volatile content of the sludge, and the liquid detention time. The three are combined to form the modified sludge factor that can be used for design and control.

Sewage sludge gas is produced by anaerobic bacterial fermentation. The gas contains from 65% to 70% methane and from 30% to 35% carbon dioxide, with traces of other gases. including nitrogen, hydrogen, oxygen, and hydrogen sulfide (37), (120), (121). The volume may vary from 0.5 to 1.3 cu ft per capita per day.

Sewage sludge gas can be used for the following: Recirculation for mixing contents in sludge digesters; fuel; and, possibly, chemical manufacture (37). Fuel uses include the following: Heating digesters and buildings; operating gas engines to drive generators and equipment; drying and incinerating sludge; truck and tractor fuel; and sale for public supply. Special precaution must be taken in collecting and using sludge gas because of its explosive properties (123). In view of the present mechanization of sewage and sludge treatment processes, the more important use for sludge gas is power production.

Elutriation is practiced with digested sludge. Two basic results are accomplished: Reduction of chemicals for conditioning for dewatering; and more compact sludge(133). Genter has defined elutriation as the process for washing out the alkalinity of the biochemically fouled sludge by dilution, sedimentation, and decantation in water of lower alkalinity (134). Van Kleeck states that elutriation should remove approximately 80% of the original total alkalinity (135).

Labor costs are favoring mechanical methods of sludge disposal (144), and the speediest method of mechanically dewatering sludge is to remove the bulk of water through some type of filtration (1). Trubnick states that the vacuum filtration of fresh solids is a unit process for sludge disposal that meets requirements of low installation cost, economical operating cost, ease of operation, minimum area, absence of nuisance, and a disposable end product (148), (152). If lime is used, the high pH is effective in reducing, and in some cases eliminating, the coliform population. Also, the potential hazard of communication of disease is greatly reduced if not eliminated by use of sanitary land fill (149). Benoit and Lea say that raw sludge filter cake can be spread on farm land or used for land-fill (153).

The role of sludge characteristics in filtration has been recognized, but practical control of same has been limited. Most of the sludge characteristics that determine filterability vary with the sludge source and methods of treatment (136), (150). Sludge characteristics include such factors as particle size, shape and density, chemical composition, solids concentration, viscosity, grease content, and compressibility. Their net effect may be summarized by a term called "filtration resistance."

Free grease in sludge can be separated from sludge solids by washing and decantation, but grease adsorbed on the sludge particles will stay with them up to the point of chemical conditioning for filtration. This grease reduces the effectiveness of chemical coagulation and increases chemical requirements(136), (141).

Drying is a method for dehydrating sludge. It is a stage process applied to the further dehydration of sludge already partially dried by air or by mechanical filtration. Drying presupposes some further step or steps for final disposal. It is too expensive a process [illegible] practice without further use, such as fertilizer or soil conditioner. When handling dried sludge for use as fertilizer, the pneumatic system for the flash-drying system and mechanical handling for the multiple-hearth furnace appears best (3).

Incineration is another method of dehydrating sludge, but it can also be considered a method of final disposal, becuase there is no practical use for ash except fill. The destruction of sludge by heat is self-supporting only when the heat available from its volatile dry matter is greater than the heat required to evaporate its water content (37). Normally, this does not become feasible until the sludge has been dried to 75% to 50% water content, depending on the efficiency of the plant used.

The Zimmerman Process may be considered a wet-incineration or wet-combustion process (158), (181). The sludge is burned under water at a pressure of 1,200 psi or higher and a temperature of approximately 500°F. Basic equipment are a reactor, air compressor, heat exchangers, and high pressure sludge pumps. The process is continuous, with the heat of combustion staying in the water to produce steam for operation. The products of combustion are cooled to 150°F and pass through a separator in which gases are vented to the atmosphere. The ash contains approximately the same amount of volatile matter (10% to 15%) as that from dry incineration.

Sewage sludge has been used with varying degrees of success as a fertilizer, its effect being dependent on climate and type of soil, as well as the type of crop under cultivation (182). Sludges compare favorably with commercially-pulverized manures in nitrogenous content. However, transportation costs in heavily-populated centers make large-scale use of sludge uneconomical. Activated and digested sludges have considerable soil-conditioning value, but their fertilizer value is limited, except for dried activated sludge (2), (4), (47), (183). Digestion reduces the nitrogen content as much as 50%.

Liquid disposal of digested sludge on land may be relatively cheap in small communities, but there are certain handicaps, such as weather, disease transmission, and public nuisance(2).

A new method of sludge disposal, supplementing disposal at sea, is now being used by the City of New York (188), (189). The Department of Public Works transports digested sludge in barges to proposed park sites, where the Parks Department removes the sludge and produces artificial topsoil. The ersatz topsoil is produced in place for approximately $1,600 per acre, as compared to $4,500 per acre for buying and placing natural topsoil. The sludge is pumped through pipes, sprayed through nozzles, allowed to dry for 2 days to 3 days, and disked into the upper 9 in. of sand cover. The operation is repeated approximately sixteen times to an area, or until 4 in. of topsoil are formed. San Diego, Calif., is also building topsoil on waste land.(109). It is possible to reclaim waste land for agricultural purposes with the application of liquid-digested sludge of reasonable solids concentration at a cost less than that for producing a dried-sludge product; it is possible to apply sludge loadings as high as 100 tons of dry solids per acre without in any way impairing crop growth; it is possible to apply sludge loadings as low as 25 tons of dry solids per acre to produce crop growth comparable to the growth achieved by the use of commercial fertilizer at conventional application rates; it is possible to grow at least a second superior crop because of the residual fertilization afforded by an initial sludging at a rate as low as 50 tons of dry solids per acre; it is possible to avoid all serious sludge-handling or nuisance problems. The fertilizer value of sludge is strongly influenced by its nitrogen content and nitrification rates (191). Both the nitrogen contents and nitrification rates of activated sludges tend to be approximately 2½ times those of digested sludges.

Reeves states that the ease with which members of the Salmonella and Shigella genera were isolated is presumptive evidence of the dangers involved in the possible dissemination of disease through the use of composted sewage sludge as a humus (198). Tests have shown that large numbers of pathogens are removed by raw sludge in settling from sewage (199). Rawn and Bowerman (200) state that the factors making the disposal of sewage sludge by dilution acceptable are the following: Bacterial decomposition in sludge digestion tanks alters the character of the crude sewage solids, changing them into relatively homogenous matter with significantly less oxygen demand and lower pathogenic content - a substance amenable to ready dispersion when mixed with volumes of water. Separate sludge outfalls may be constructed when mixing of digested sewage sludge with effluent may jeopardize health and safety standards. Separate sludge outfalls, being small-diameter pipes, can be placed economically and carried to such distances and depths as to ensure satisfactory disposal, provided that oceanographic considerations are observed in the design and location of the outfall.

Vitamin $B_{12}$ has great value for animal-feed enrichment. It is produced by fermentation processes, and tests show that recovery from dried, undigested, activated sludge is the cheapest known method (204). The vitamin $B_{12}$ is extracted with water and concentrated, leaving a redried sludge essentially unchanged in fertilizer value. Activated sludge at levels of 0.5% to 2.0% is a satisfactory source of vitamin $B_{12}$ for the pig and chicken; activated sludge at levels of 2% to 3% furnishes unknown growth factors for the chicken beyond that produced by crystalline $B_{12}$; activated sludge used with stabilized vitamins produces no rickets in the chicken; activated sludge is a source of amino acids for animal feeds, all the essential amino acids, with the exception of methionine-cystine, being present in adequate amounts; activated sludge is a source of nitrogen for the ruminants, nitrogen retention from activated sludge being equal to that from soybean-oil meal or urea; there are no pathological symptoms produced in the tissue of either the pig or the chicken.

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**Descriptors (Continued from page 1)**

raw sludge filter cake
land-fill
filtration resistence
grease
chemical coagulation
drying
dehydration
flash-drying system
incineration
tne Zinnerman Process
wet-incineration
manures
liquid disposal
public nuisance
artificial topsoil
waste land
Shigella genera
Salmonella
composted sewage
humus
pathogens
bacterial decomposition
dispersion
sludge outfalls
safety
vitamin $B_{12}$
animal-feed enrichment
fermentation
crystalline $B_{12}$
stabilized vitamins
amino acids
rickets

**Disease/Solid Waste Abstracts**

No. DSW-217

**Author**

Louis Koenig

**Title**

Advanced Waste Treatment

**Reference**

Chemical Engineering, June 10, 1963

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pp. 210

**Abstract**

The purpose of conventional treatment is to reduce the residual contaminant in the effluent, particularly organic and pathogenic contaminants, to the point where, upon dilution in the receiving water body and subsequent natural purification, the level of contamination will be tolerable to the next user.

AWT is sometimes referred to as "tertiary treatment", implying that it will be another treatment stage tacked onto conventional secondary treatment. This may well be true, but AWT may also be applied directly to the raw waste, or at any intermediate stage of the conventional system, so as to yield the most economic over-all system for accomplishing its objectives. Conventional processes, removing at best about 95% of the organic materials present in raw municipal waste, were adequate so long as large dilution and long retention time before subsequent reuse were available in the receiving water body, typically a river. Two factors have shown up this inadequacy. First, the modern chemical industry has developed and put into widespread use "exotic" materials that are highly refractory to biological treatment processes.

Second, the withdrawal of water from the fixed annual water supply is increasing.

It is thus that AWT can be defined as "processes to make water indefinitely reusable."

Although making water directly and indefinitely reusable is the ultimate goal of AWT...an advanced-treatment process would be helpful if it removed an appreciable portion of the present refractory substances such as alkylbenzene sulfonate.

There are ten AWT processes now under investigation.

Soil Spreading - ...the work at the Taft Sanitary Engineering Center...shows that intermittent spreading of secondary effluent achieves a high degree of treatment

**Descriptors**

advanced waste treatment
pathogenic
"tertiary treatment
refractory substances
flocculation & sedimentation
volatile
freezing
electrodialysis
activated carbon
chemical or electrochemical oxidation
organic electrode reactions
injection
conveyance to the ocean

contaminant
purification
waste
soil spreading
soil materials
condensate
eutectic freezing
ion exchange
foam separation
Zimmermann process
underground cavities

organic
AWT
reuse
inorganics
distillation
dissolved-solids
solvent extraction
adsorption
ABS
ultimate disposal
incineration
preconcentrating

Abstract (continued)

by oxidation in the unsaturated zone of aeration and removes as high as 99% of the organics.

Finally, other investigations have shown that the cost of spreading is extremely low per 1,000 gal., even when land costs are quite high. All these factors make soil spreading very interesting as an intermediate AWT method in situations where the ground water is normally usable and where the ratio of artificial to natural recharge is small so that a high dilution factor is achieved. As an AWT process for the ultimate goal, 100% recycling, soil spreading is of no interest because it removes but a small part of the inorganics.

Flocculation and Sedimentation - The work of LaMer (Columbia University) on flocculation and dewatering of uranium slimes is being extended to colloidal materials that might be expected in AWT processes. This work demands an entirely different theory for the action of polyelectrolytes upon colloidal dispersions, one involving chemical interactions rather than the electric double-layer.

Distillation - ...in AWT, some of the organics and a small percentage of the inorganics are volatile and appear in the condensate. By combining distillation with another process, such as adsorption that will remove organics whether volatile or not, one would achieve a composite process to make water indefinitely reusable.

In AWT, the total dissolved-solids concentration of the feed is substantially less than in saline water conversion. Unfortunately this does not appreciably help the economics of AWT distillation, the cost of which is relatively independent of feed concentration.

Freezing - In AWT by freezing (including the hydrate modification), an improvement may be expected over saline-water conversion because of lower feed concentration. Eutectic freezing may also freeze out much of the organics due to the salting-out effect. One major unresolved problem is the fate of the organics in the freezing process. If they are adsorbed on or occluded in the ice crystals, they will appear as contaminant in the product.

Solvent Extraction - The distribution coefficients of some of the organic matter, specifically ABS, are such that the concentration in the solvent phase is 35 to 40 times that in the water phase, and solvent extraction thus offers the possibility of removing both organic and inorganic impurities in a single operation.

Electrodialysis - Organics in the effluent interfere with the action of the membranes,...one approach si to use special membranes resistant to organic fouling. Another approach is prior removal of the organics.

Ion Exchange - Ion exchange may be used to remove small concentrations of metals. Ion exchange also removes ionized organic materials. Following the original work of Abrams and Lewon (Diamond Alkali), much work has been done on removing ABS from laundry effluents, and various proprietary schemes are available or under study. These studies show that ion exchange warrants more consideration.

Adsorption - Activated carbon is the common adsorbent in water treatment but because of its high cost studies have been made to find others. So far, however, activated carbon retains its superiority.

Activated carbon for AWT is preferred in the granular form. Basic work on the physical chemistry of adsorption by activated carbon has been performed by Morris and Weber (Harvard University). Leverdusky, et al. (Graver Water Conditioning Co.) and Battey (FMC Corp.) have studied granular carbon adsorption, and Sukenik and

## Abstract (continued)

Joyce (Pittsburgh Chemical) have investigated a continuous, granular carbon process that reduced chemical oxygen demand to 16 ppm and ABS content to well below 0.5 ppm at flow rates as high as 10 gpm/sq ft. Over-all treatment costs are estimated at 6 to 8¢/1,000 gal. Dow Chemical Co. has found that chemical regeneration of activated carbon is not feasible.

Foam Separation - The waste is subjected to bubbling with air, and the surface-active materials in its concentrate on the bubble surfaces and are removed with the foam. By this means, ABS, for example, may be removed down to 0.5 ppm., at which point foaming ceases. Some...studies show that ABS may be reduced below 0.5 ppm., with concurrent removal of about 20% of the other organics. Operating costs are about 2.5¢/1,000 gal. at 10 mgd. and considerably higher at lower rates.

Chemical or Electrochemical Oxidation - Oxidation of the organic contaminants is being studied in an intramural program at the Taft Sanitary Engineering Center and under contract with Monsanto Chemical Co. Catalyzed $H_2O_2$ is an efficient but costly oxidant. It is likely that basic studies in organic electrode reactions may be applied to this problem.

When pure $H_2O$ is produced from the raw material, there remains a waste product that must be disposed of. What is needed is ultimate disposal of these wastes so that they will never again contact human activity.

Studied so far have been wet oxidation (Zimmermann process) as a preparation for ultimate disposal; incineration, with hauling of the final wastes to the ocean; injection to permeable underground formations; spreading on soil; and placement in underground cavities. Still to be studied are conveyance to the ocean, dumping in isolated regions, as well as the economic possibilities for preconcentrating the wastes before ultimate disposal, and the possibilities of actual utilization of the wastes. The major problem in ultimate disposal comes not from the organics but from the inorganics.

After soil spreading, the cheapest method is injection to deep permeable formations. Costs of the other methods so far studied are higher than this and demand a very high recovery in the separation process to add less than 10¢/1,000 gal. of product. For example, to reach 10¢/1,000 gal. in disposal by incineration and hauling from the center of the country to the ocean requires 95% recovery in the separation.

...It is quite feasible physically and economically to haul solid wastes by railroad car from any point in the nation to the nearest ocean for disposal.

Market studies and general economic studies are also under way to determine the potential market for AWT and to assay the effects on various segments of the economy that would result from its wholesale application. Preliminary indications are that markets will be large and that the effect on some unsuspected segments of the economy may be drastic.

**Disease/Solid Waste
Abstracts**

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**Author**

Rolf Eliassen

**Title**

Challenges in Research & Development

**Reference**

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**Abstract**

Today the manifold needs for water in the United States total 280 bil gal/day and it is predicted that in 1980 the demand will be 600 bil gal/day. The planners also say that the available supply of water in lakes and streams will be 515 bil gal/day, or 85 bil gal/day less than the predicted use by 1980.

Reuse of water is the answer to this dilemma.

Most of the sewage treatment processes now used are essentially those which were developed thirty or forty years ago. Secondary treatment of the biological types, such as biological filters and activated sludge, removes 85 to 90 percent of the organic matter which can be readily oxidized by biological organisms. Physical removal of approximately 90 percent of the heavier or suspended solids also takes place. However, these processes do not remove inorganic, dissolved chemicals, and many of the more resistant organic chemicals which are not readily degradable by microorganisms. It is not expected that secondary treatment processes will remove these non-degradable organics; the use of tertiary treatment will be advised for such special situations.

The primary stage usually involves a physical unit operation such as sedimentation, while the secondary may involve biological or chemical processes. Synthetic detergents, pesticides of all kinds, and other petrochemicals are examples of contaminants which are not readily removed by the primary and secondary treatment, nor by the natural stream purification processes. Thus, they may persist almost indefinitely and even pass modern water treatment plants without being removed, or even being detected.

The research areas which have shown promise of havinb economic and practical feasibility are: (a) adsorption by activated carbon and other substances; (b) foam fractionation; (c) gas hydration; (d) ion exchange processes, including electrodialysis;

**Descriptors**

research
secondary treatment
non-degradable organics
chemical processes
petrochemicals
foam fractionation
electrodialysis
distillation
epidemiological studies
bacterial contamination
reclamation
biological filters
suspended solids
tertiary treatment
synthetic detergents
contaminants
gas hydration
freezing
waste disposal
toxic
enteric viruses
sewage
activated sludge
microorganisms
sedimentation
pesticides
adsorption
ion exchange processes
solvent extraction
pollution
endemic
infectious hepatitis

Abstract (continued)

(e) freezing; (f) solvent extraction; and (g) distillation.

In addition to economic effects of waste disposal, the pollution effects of wastes must be considered and may, indeed, govern many situations. First of these is the possibility of a toxic effect of a particular waste on human beings. Research should consider the possibility of the development of rapid screening tests for waste materials which may have a possibility of being hazardous to humans.

No studies of the pollutional effects of wastes would be complete without relating them to epidemiological studies. Even though tests previously described might not disclose toxic effects on humans, there is evidence of endemic occurrences of intestinal disease attributable to water supplies as a result of epidemiological investigations.

Improved indices of bacterial contamination are required to achieve realistic standards. Enteric viruses must be identified more readily than is presently possible. The role of water in transmitting viruses is not known, nor has any reasonable standard been developed for the incidence of viruses in water. It is known that viruses will pass through water and sewage treatment plants and may persist in polluted waters, inasmuch as outbreaks of infectious hepatitis have been traced to polluted drinking water.

How much more attractive should reclamation of sewage be when it is considered that sewage is approximately 99.9 percent pure water, while sea water is only 96.5 percent pure water. On the face of this, it should be evident that the reclamation of sewage would be more economical than the reclamation of sea water.

Disease/Solid Waste
Abstracts

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Author

Charles B. Lipsett

Title

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Reference

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Abstract

PREFACE

Large scale expansion of world industrial and mobilization programs continue to create critical shortages of various raw materials and more than ever turns the spotlight on the strategic importance of scrap and waste materdals as a vital secondary source of supply.

There is hardly a manufacturing industry that does not produce some waste materials in the course of its operation; and there are few commodities that are used by industry that do not contain some scrap. The popular conception of waste or scrap is that it is some commodity that has been discarded because it has outlived its usefulness. It may be an old piece of machinery on the farm or in the factory, some old household stove or utensil or tea kettle, some old clothing, rags or waste paper, broken glass or plastic scrap. The steel that goes into the construction of a giant battleship may have been made partially with scrap iron, and in the process of building the battleship, more scrap will be produced, which will again be consumed in some form by the steel industry. In the construction of an airplane, which is made largely out of aluminum, a great deal of scrap is produced, which will again find its way into the products that are also made out of aluminum; and the same applies to the aluminum that has been salvaged from old planes. The same situation prevails in the manufacture of cloth. In the process of spinning cotton, wool, silk or rayon, wastes are produced that can be used after being properly treated. In making the cloth some reworked wool or other textile waste may have been incorporated, and when the cloth is cut up to make apparel, a great many more rags, called "clippings" are produced, which will find their way into other commodities. In the fabrication of plastics a waste is produced that is then utilized. Chemicals are a great source of waste products which are reused in the production of other chemical compounds, and so the cycle continues.

Descriptors

waste
scrap
residue
soil conditioner
fruit & Vegetable wastes
health hazard
disposal
soft-grit blasting method
pear-cannery waste
microbiological culture medium
brewing waste
nonferrous scrap metals
brass & bronze scrap
chemical residues
platinum scrap
non-metallic wastes
reclaimers
grinders
sawmill wasge
"wood flour"
packing wastes
public nuisance
pollution
chicken litter
fatty acids
fermentation
waste paper
copper scrap
segregation
solids
magnetizing
acid stripping
reprocessors
wood waste
mill wasge
processing wastes
canning wastes
noxious
abrasives
furfural
"still pitch"
soil conditioners
manufacturing wastes
slag or drosses
lead scrap
industrial scrap
grease
photographic wastes

## Abstract (continued)

There is hardly a commodity in which this process of producing and utilizing some form of scrap or waste materials does not occur, whether it be textile fibres, leather, glass, paper, chemicals, metals, etc. Were it not for the utilization of these waste materials, there would not be sufficient raw materials in the world to take care of the needs of the basic industries.

Obviously all these scrap and waste products or secondary raw materials are important to the economy of every nation. Many foreign countries lack important raw materials and resort to the use of waste and scrap to supply their industries. Japan is a heavy importer of scrap iron, Italy is an importer of woolen rags, West Germany is a large importer of scrap metals. Rayon and other fibers used by U.S. textile manufacturers produce wastes for export around the globe, as well as being reprocessed and recycled into industry in the United States. Even used clothing, always in demand in underprivileged areas around the globe, has found new markets in the developing new nations. Other nations are also large producers and users of waste in their manufacturing operations. Because there may be a shortage of waste products in one country and a surplus in others there is a large import and export business in such products in every industrialized nation. Labor costs in themselves are a factor. It has proved economic to ship certain mixed scrap to foreign countries for segregation and return to the generating nation, the cheaper labor cost more than paying for freight both ways.

The purpose of this revised second edition is to present to industry and the public an acquaintanceship with the principal scrap and waste materials produced and consumed by industries, to acquaint them with their sources of supply, how and by whom they are produced, how they are bought and sold, and how they are handled and processed so that they are again suitable for use in making other commodities.

## Descriptors (continued)

electrolysis
chemical wastes
solvent-extraction process
still residues
dryhouse
wool mill waste
rayon waste
soft sewwping wastes
jute wastes
citrus wastes
salvage
recovery
cholesterol
sulphite waste liquor
waste solvents
fertilizer
wool noils
cotton comber waste
clearer wastes
silk wastes
dumps
junked cars
salvage
pollution controls
combustible wastes
distillery wastes
cotton linters
wool shoddy
soft picker waste
hard cotton wastes
cane waste
automobile scrapping